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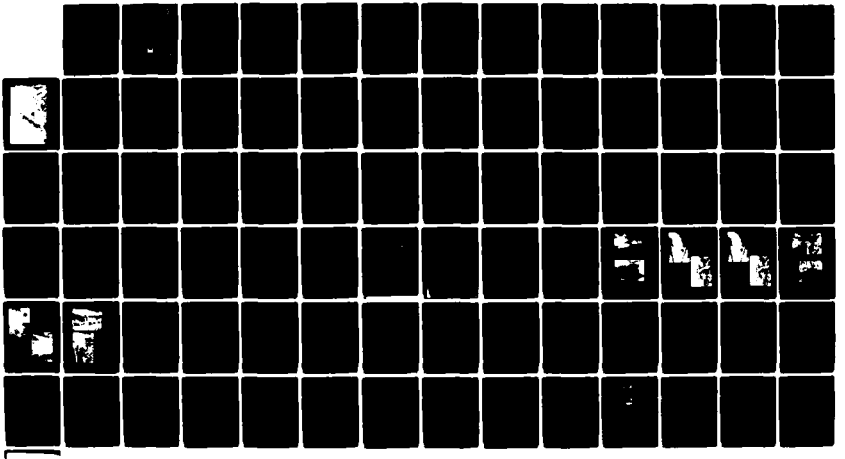

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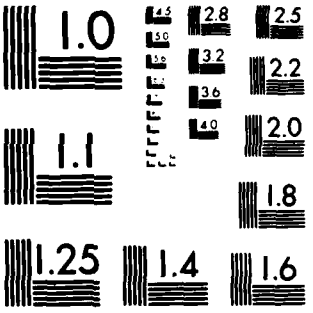

NAUGATUCK RIVER BASIN

PROSPECT, CONNECTICUT

WATERBURY RESERVOIR NO.2 DAM
CT 00304

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

SEPTEMBER 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Naugatuck River Basin
Prospect, Connecticut

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Waterbury Reservoir No.2 Dam consists of an earth embankment with a downstream stone masonry wall. The dam has a top width of 22 ft., a maximum height of 20 ft., and an overlal length of 230 ft. including a 40 ft. long overflow spillway located near the left end of the dam. Based on the visual inspection, the dam is judged to be in poor condition. The dam is classified as "Small" in size with a "High" hazard potential. A test flood equal to ½ the PMF was selected.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

JAN 07 1981

Honorable William A. O'Neill
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor O'Neill:

Inclosed is a copy of the Waterbury Reservoir No. 2 Dam (CT-00304) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, The City of Waterbury, Bureau of Water, Waterbury, CT 06708.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Division Engineer

Incl
As stated

WATERBURY RESERVOIR NO. 2 DAM
CT 00304

NAUGATUCK RIVER BASIN
PROSPECT, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

49-025

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NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

IDENTIFICATION NO: CT 00304

NAME OF DAM: Waterbury Reservoir No. 2 Dam

TOWN: Prospect

COUNTY AND STATE: New Haven County, Connecticut

STREAM: Turkey Hill Brook

DATE OF INSPECTION: July 28, 1980

BRIEF ASSESSMENT

Waterbury Reservoir No. 2 Dam consists of an earth embankment with a downstream stone masonry wall. The dam has a top width of 22 feet, a maximum height of 20 feet, and an overall length of 230 feet including a 40 foot long overflow spillway located near the left end of the dam. The outlet works consist of a gate chamber at the right of the spillway, and a 12-inch cast iron pipe extending approximately 100 feet downstream of the dam.

The dam impounds Waterbury Reservoir No. 2 which was formerly used as a storage reservoir for public water supply and currently serves no formal purpose.

Based on the visual inspection, the dam is judged to be in poor condition. Features that could affect the future integrity of the dam are seepage at the base of the masonry wall and downstream of the dam; erosion of the upstream slope and crest; and the inaccessibility of the low level outlet or blowoff gates.

The dam is classified as "Small" in size with a "High" hazard potential. A test flood equal to one-half the Probable Maximum Flood (1/2 PMF) was selected in accordance with the Corps of

Engineers' Recommended Guidelines for Safety Inspection of Dams. The test flood inflow is 490 cfs and the test flood routed outflow is 263 cfs, which results in 0.6 feet of freeboard from the water surface to the top of the dam.

The spillway capacity with the water level at the top of the dam is 410 cfs and is equal to 156 percent of the test flood routed outflow.

It is recommended that a qualified, registered engineer be retained to investigate the seepage at the base of the stone masonry wall and downstream of the dam; oversee tree removal; evaluate the spillway discharge channel; investigate the condition of the stone masonry wall; recommend repairs to the upstream slope and crest; and investigate the condition of the low level outlet or blowoff. In addition, the dam should be inspected annually by a qualified, registered engineer, an operation and maintenance manual should be prepared and a formal warning system put into effect.

The owner should implement these recommendations as described herein and in greater detail in Section 7 of the Report within one year after receipt of this Phase I Inspection Report.

Ronald G. Litke, P.E.
Project Engineer

Roald Haestad
President

This Phase I Inspection Report on Waterbury Reservoir No. 2 Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the

condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety of the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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U.S ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ROALD HAESTAD, INC
CONSULTING ENGINEERS
WATERBURY, CONNECTICUT

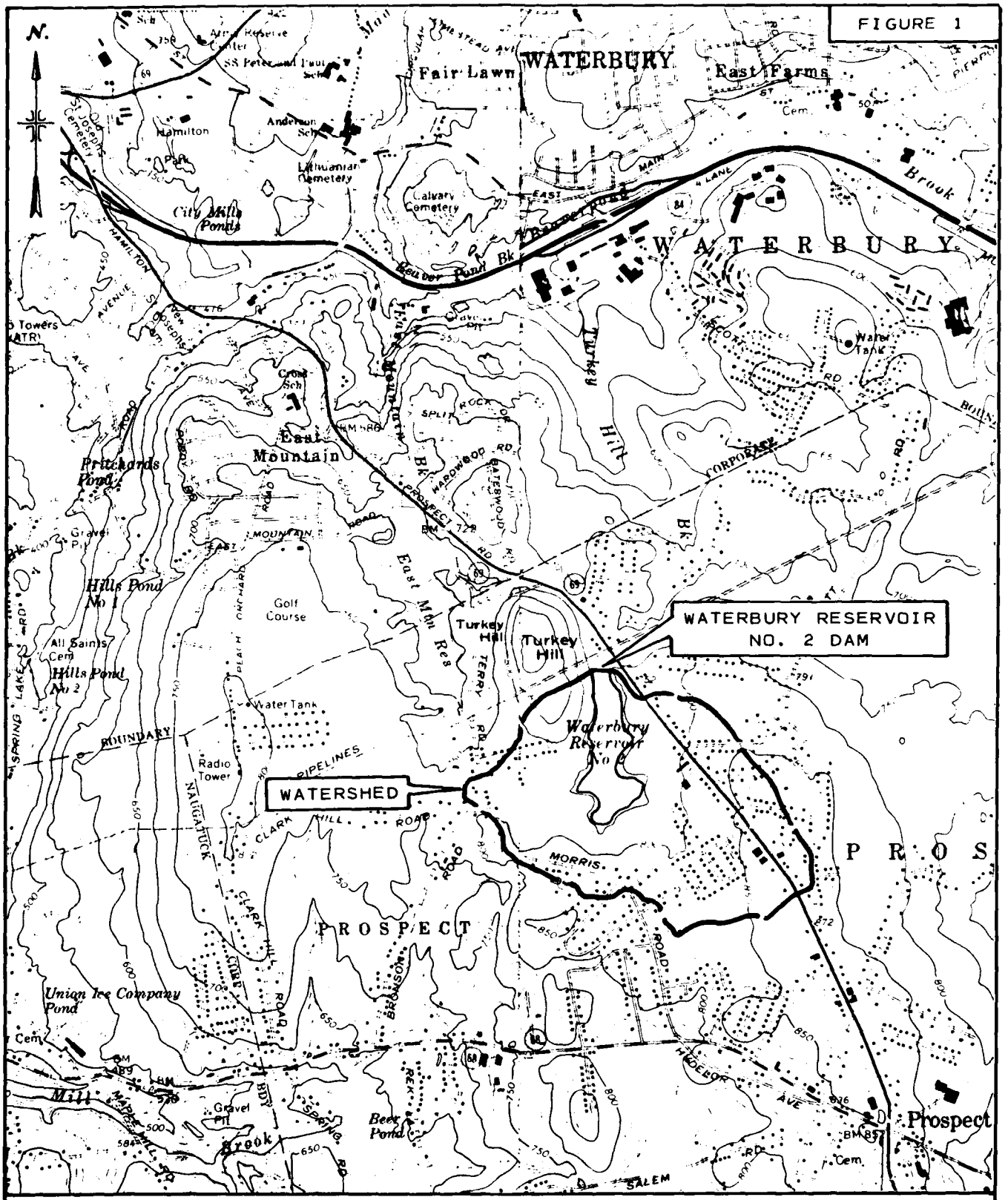
NATIONAL PROGRAM OF
INSPECTION OF
NON-FED DAMS

WATERBURY RESERVOIR NO. 2 DAM - CT [illegible]

TURKEY HILL BROOK

PROSPECT, CONNECTICUT 19 APRIL [illegible]

FIGURE 1



LOCATION PLAN

WATERBURY RESERVOIR NO. 2 DAM
PROSPECT, CONNECTICUT

SCALE: 1" = 2000' WATERBURY QUADRANGLE 1972
SOUTHINGTON QUADRANGLE 1972

ROALD HAESTAD, INC.

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

PROJECT INFORMATION
SECTION 1

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Roald Haestad, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Roald Haestad, Inc., under a letter of April 14, 1980, from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0048 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interest.
2. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.
3. To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

The dam is located on Turkey Hill Brook approximately 250 feet west of Connecticut Route 69 in Prospect, Connecticut near the corporate boundary between Waterbury and Prospect. The dam is shown on the Southington Quadrangle map having coordinates of latitude N41° 31.3' and longitude W72° 59.7'.

b. Description of Dam and Appurtenances

The Waterbury Reservoir No. 2 Dam consists of an earth embankment with a downstream stone masonry wall. The dam has a top width of 22 feet, a maximum height of 20 feet, and an overall length of 230 feet, including a 40 foot long overflow spillway located near the left end of the dam. The upstream slope of 2 horizontal to 1 vertical is partially protected by a layer of stone riprap. The downstream stone masonry wall has a top width of 5 feet and a batter of 1 horizontal to 12 vertical on the downstream face. A portion of the top of the wall is covered with a thin concrete cap. The overflow spillway consists of a stone masonry weir with a top width of 3 feet and stone masonry training walls. The distance from the spillway crest to the top of the dam is 2 feet. Several stones are missing from the right end of the spillway, making a notch approximately 5 feet long and up to 2 feet deep. There are low training walls on either side of the spillway discharge channel below the dam. The outlet works consist of a gate chamber to the right of the spillway and a 12-inch cast iron low level outlet or blowoff pipe which ends approximately 100 feet downstream of the dam. The outlet pipe was laid above ground. A concrete slab has been poured

over the top of the chamber to eliminate vandalism to the gates within the chamber. No information was available as to the number, size, location or type of gates within the chamber.

c. Size Classification - "Small"

According to the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the dam is classified as "Small" in size if the height is between 25 feet and 40 feet or if the dam impounds between 50 Acre-Feet and 1,000 Acre-Feet. The dam has a maximum height of 20 feet and a maximum storage capacity of 321 Acre-Feet. Therefore, the dam is classified as "Small" in size based upon a maximum storage capacity of 321 Acre-Feet.

d. Hazard Classification - "High"

Based on the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the hazard classification of the dam is "High". A dam failure analysis indicates that 7 homes in the area of Connecticut Route 69 downstream of the dam would be flooded up to 6 feet above sill elevation, and 2 homes in the Sherwood Drive area would be flooded up to 2 feet above sill elevation. The flood waters would inundate several commercial and residential establishments along Reidville Drive and overtop Interstate 84. Several homes along Plank Road would also be flooded before the waters reached the Mad River. The failure of Waterbury Reservoir No. 2 Dam could result in the loss of more than a few lives.

e. Ownership

The City of Waterbury
Bureau of Water
Benedict H. Ebner, Superintendent
21 East Aurora Street
Waterbury, Connecticut 06708
(203) 574-8251

f. Operator

Leonard Assard, Superintendent of Reservoirs
Bureau of Water
21 East Aurora Street
Waterbury, Connecticut 06708
(203) 574-8251

g. Purpose of Dam

The dam was formerly used to store water for public water supply and currently serves no formal purpose.

h. Design and Construction History

The dam was constructed around 1880. No information was available on the design or construction of the dam. Around 1970 the gate house was removed and a concrete slab placed over the top of the gate chamber to eliminate vandalism.

i. Normal Operational Procedures

There are no operational procedures in effect for the dam.

1.3 Pertinent Data

a. Drainage Area

The drainage area consists of 0.46 square miles of wooded "rolling" terrain with considerable residential development located in the southern and eastern portions of the watershed.

b. Discharge at Damsite

Discharge at the damsite is normally over the damaged portion of the spillway. A concrete slab has been poured over the top of the gate chamber making the gates inaccessible.

1.	Outlet Works (conduits) Size:	12-inch*
	Invert Elevation: (Downstream)	721.4
	Discharge Capacity:	12 cfs
2.	Maximum Known Flood at Damsite:	Unknown
3.	Ungated Spillway Capacity** at Top of Dam:	410 cfs
	Elevation:	747
4.	Ungated Spillway Capacity** at Test Flood Elevation:	263 cfs
	Elevation:	746.4
5.	Gated Spillway Capacity at Normal Pool Elevation:	N/A
	Elevation:	
6.	Gated Spillway Capacity at Test Flood Elevation:	N/A
	Elevation:	
7.	Total Spillway Capacity** at Test Flood Elevation:	263 cfs
	Elevation:	746.4
8.	Total Project Discharge** at Top of Dam:	410 cfs
	Elevation:	747
9.	Total Project Discharge** at Test Flood Elevation:	263 cfs
	Elevation:	746.4

* Outlet gates are inaccessible

** With stones missing from spillway

c. Elevation - Feet Above Mean Sea Level (NGVD)

1. Streambed at Toe of Dam:	727
2. Bottom of Cutoff:	Unknown
3. Maximum Tailwater:	N/A
4. Recreation Pool:	N/A
5. Full Flood Control Pool:	N/A
6. Spillway Crest	745 (743 w/missing stones)
7. Design Surcharge - Original Design:	Unknown
8. Top of Dam:	747
9. Test Flood Surcharge:	746.4

d. Reservoir - Length in Feet

1. Normal Pool:	2,350 feet
2. Flood Control Pool:	N/A
3. Spillway Crest Pool:	2,350 feet
4. Top of Dam:	2,400 feet
5. Test Flood Pool:	2,400 feet

e. Storage - Acre-feet

1. Normal Pool:	206 Acre-Feet
2. Flood Control Pool:	N/A
3. Spillway Crest Pool:	260 Acre-Feet
4. Top of Dam:	321 Acre-Feet
5. Test Flood Pool:	303 Acre-Feet

f. Reservoir Surface - Acres

1. Normal Pool:	26 Acres
2. Flood-Control Pool:	N/A
3. Spillway Crest:	29 Acres
4. Test Flood Pool:	31 Acres
5. Top of Dam:	32 Acres

g. Dam

1.	Type:	Earth embankment with downstream stone masonry wall
2.	Length:	230 feet
3.	Height:	20 feet
4.	Top Width:	22 feet including 5 foot top width of stone masonry wall
5.	Side Slopes:	Upstream: 2 horizontal to 1 vertical Downstream Wall: 1 horizontal to 12 vertical
6.	Zoning:	Unknown
7.	Impervious Core:	Unknown
8.	Cutoff:	Unknown
9.	Grout Curtain:	N/A
10.	Other:	

h. Diversion and Regulating Tunnel N/A

i. Spillway

1. Type:	Stone masonry weir 3 feet wide at the top with a vertical downstream face and upstream earth embankment
2. Length of Weir:	40 feet
3. Crest Elevation with Flash Boards: without Flash Boards:	 N/A 745
4. Gates:	N/A
5. Upstream Channel:	N/A
6. Downstream Channel:	Natural Streambed
7. General:	Several stones are missing from the right end of the spillway making a notch approximately 5 feet long and up to 2 feet below spillway crest of 745.

j. Regulating Outlets

1. Invert:	721.4 at outlet 100 feet downstream of dam.
2. Size:	12-inch
3. Description:	Cast iron capacity = 12 cfs
4. Control Mechanism:	Unknown
5. Other:	Concrete slab poured over top of gate chamber making gates inaccessible.

2.1 Design Data

There was no design data available for review.

2.2 Construction Data

There was no construction data available for review. It was reported that the dam was constructed around 1880 in order to increase the storage of an existing natural pond so that it could be used as a water supply reservoir. The owner also reported that the gate house was removed and a concrete slab installed over the top of the gate chamber around 1970 in order to eliminate vandalism.

2.3 Operation Data

The reservoir is no longer used for water supply and operation data is not kept.

2.4 Evaluation of Data

a. Availability

Design or construction data was not available from the State of Connecticut Department of Environmental Protection or the City of Waterbury, owner of the dam.

b. Adequacy

As no design or construction information was available, the assessment of the condition of the dam was based on the visual inspection, past performance history, and hydraulic and hydrologic calculations performed for this Report.

c. Validity

The cast iron outlet pipe was dated 1880, indicating that the dam was constructed around 1880 as reported.

VISUAL INSPECTION

SECTION 3

3.1 Findings

a. General

The visual inspection of the dam was conducted on July 28, 1980. At the time of inspection the water level was approximately 2 feet below spillway level with water flowing over the right end of the spillway, where several stones were missing.

Waterbury Reservoir No. 2 Dam consists of an earth embankment with a downstream stone masonry wall. An overflow spillway is located near the left end of the dam and the outlet works are located to the right of the spillway.

The general condition of the dam at the time of inspection was poor.

b. Dam

The upstream slope above the water line is generally covered with weeds, brush and small trees to about 3 inches in diameter, Photo 1. There is intermittent riprap overgrown with weeds and brush, Photo 1. The upstream slope is severely eroded to the right of the gate chamber, Photo 2. Footpaths from the crest to the water have been eroded in several places along the right half of the dam.

The crest of the dam is generally level, except for the area to the right of the gate chamber, where the crest has been severely eroded. There is a well-worn footpath along the center of the crest. The crest is covered with brush and small trees up to 3 inches in diameter. There is a hole in the dam crest about

4 inches in diameter and 18 inches deep at the back of the downstream wall.

The downstream mortared stone wall is nearly vertical with about a 1 horizontal to 12 vertical batter, Photo 3. There is a concrete cap on portions of the wall. The wall is heavily overgrown with large vines, Photo 3, and there is a 6 inch diameter tree growing out of the wall to the right of the spillway, Photo 4. The mortar is missing in some sections of the wall and voids up to 3-1/2 feet deep were found by probing with the folding rule, Photo 5.

Seepage was noted along the entire toe of the downstream wall from the left side of the spillway to about 60 feet right of the spillway. About 30 feet right of the spillway an open channel extended back under the wall for a distance of about 12 inches, Photo 6. The flow from this seep was clear with a slight presence of rust-colored floccules. Similar open seepage channels and flow were observed near the center and at the left end of the spillway. The entire toe area at the base of the wall was stained a rusty orange color.

Seepage was also noted about 60 and about 100 feet downstream of the dam and to the right of the low level outlet or blow-off pipe. (See Figure 2, page B-1 in Appendix B.) The seepage occurred in areas where there appeared to be clusters of cobbles and small boulders. These seepage areas were also stained a rusty orange color.

The entire downstream toe area is marshy and covered with moisture-loving vegetation and trees up to 12 inches in diameter.

c. Appurtenant Structures

The appurtenant structures consist of the overflow spillway and the outlet works.

Overflow Spillway

The spillway crest is formed of mortared stone, with one or more stones missing at the right end, Photo 7. The spillway crest is very uneven and the mortar holding the remaining stone is broken and missing in some places. Portions of the crest are overgrown with weeds and brush.

The downstream face of the spillway is a continuation of the downstream stone masonry wall. The mortar is missing and there are voids between many of the stones, Photo 8.

The spillway approach channel has unmortared stone training walls with frequent large voids, Photo 9. The right training wall is also one of the gate chamber walls. The floor of the channel was submerged and could not be observed.

Outlet Works

The outlet works consist of a gate chamber located at the right end of the spillway which discharges through a 12-inch cast iron low level outlet or blowoff pipe. An above-ground gate house has been removed and a concrete slab poured over the top of the gate chamber, Photo 9, making the gates inaccessible. The low level outlet or blowoff pipe is laid on top of the ground, Photo 10, and discharges approximately 100 feet downstream of the dam. There was no flow from the pipe and no evidence of any recent flows.

d. Reservoir Area

There are no indications of instability along the edges of the reservoir in the vicinity of the dam.

e. Downstream Channel

The spillway discharge channel is the natural streambed, lined with sand, gravel and cobbles. No channel protection was observed at the base of the spillway wall. There are 3 foot high stone training walls on each side of the channel that extend about 20 feet downstream, Photo 10. The channel is heavily overgrown with brush, vines and trees, Photo 10. A large pile of debris blocks the center and right side of the channel, at the base of the spillway, Photo 10.

3.2 Evaluation

Based on the visual observations, the dam appears to be in poor condition. The following features could affect the future integrity of the dam:

1) Seepage at the base of the downstream wall may cause internal erosion, leading to piping failure of the foundation or embankment.

2) Severe erosion on the upstream slope and crest near the gate chamber could cause overtopping or concentrated seepage through the dam, resulting in breaching of the dam.

3) Missing stones and deteriorated mortar in the spillway crest and downstream wall could lead to failure of the spillway and breaching of the dam.

4) The abandoned and inaccessible low level outlet or blow-off makes it difficult to lower the reservoir level in an emergency.

5) Voids in the downstream wall may permit internal erosion of the embankment due to seepage, leading to piping failure of the embankment.

6) Debris and heavy overgrowth in the spillway discharge channel may cause flooding and diversion of the flow from the natural channel, leading to erosion and undermining of adjacent sections of the downstream wall.

7) Discharge over the spillway into an unlined channel could cause undermining of the wall, leading to failure of the spillway and breaching of the dam.

8) The roots of trees and vines growing on the downstream wall could dislodge stones and provide seepage paths for internal erosion of the embankment.

9) Trees in the immediate downstream area and on the crest and upstream slope of the dam could be overturned during a storm, leaving open root holes which may act as seepage paths, leading to piping of the foundation or embankment soils.

OPERATIONAL AND MAINTENANCE PROCEDURES
SECTION 4

4.1 Operational Procedures

a. General

As the reservoir is no longer used for water supply, there are no operational procedures in effect for the dam.

b. Description of Any Warning System In Effect

There is no formal warning system in effect for the dam.

4.2 Maintenance Procedures

a. General

There are no maintenance procedures in effect for the dam.

b. Operating Facilities

There are no maintenance procedures in effect for the operating facilities. A concrete slab was placed over the top of the gate chamber approximately 10 years ago, making the gates inaccessible.

4.3 Evaluation

Present operational and maintenance procedures are inadequate, as is evident by the general condition of the dam and operating facilities. An operations and maintenance manual should be prepared for the dam and operating facilities, and a program of annual technical inspections by qualified, registered engineers should be instituted. A formal warning system should be put into effect and include monitoring the dam during extremely heavy rains and procedures for notifying downstream authorities in the event of an emergency.

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

SECTION 5

5.1 General

The spillway at Waterbury Reservoir No. 2 Dam is a broad crested weir located near the left end of the dam. The spillway is constructed of stone masonry 3 feet wide at the top with a vertical downstream face. Several large stones are missing from the right end of the spillway so that the spillway crest in that area is as much as 2 feet lower than the rest of the spillway. The spillway flow is concentrated in the area of the missing stones with the remainder of the spillway overgrown with weeds and brush. The total spillway length is 40 feet. The top of the dam is 2 feet above the undamaged spillway level.

The dam has a tributary watershed of 0.46 square miles. The terrain is "rolling" wooded hills with considerable residential development located in the southern and eastern portions of the watershed. The watershed has a maximum elevation of 870 at the southeast end and an elevation of 743 at the spillway.

There is no operable outlet for the dam.

A 12-inch cast iron low level outlet or blowoff pipe was observed below the dam. The gatehouse has been removed and a concrete slab poured over the top of the gate chamber. If operable, the capacity of the outlet would be about 12 cfs.

5.2 Design Data

No design data was available for the dam or the spillway.

5.3 Experience Data

No records of past flood experience were available.

5.4 Test Flood Analysis

Based on the dam failure analysis, the dam is classified as "High" hazard potential. The dam is classified as "Small" in size, based on a height of 20 feet and a storage capacity of 321 Acre-Feet. According to the Recommended Guidelines for Safety Inspection of Dams, by the Corps of Engineers, the test flood should be in the range of 1/2 the Probable Maximum Flood (1/2 PMF) to the Probable Maximum Flood (PMF). A test flood equal to 1/2 PMF was selected because the height and storage capacity are in the low range for a small dam. The test flood was calculated using a peak flow of 2,125 cubic feet per second per square mile (csm) for the PMF from the minimum 2 square mile drainage area shown on the guide curves supplied by the Corps of Engineers and the 0.46 square mile watershed of Waterbury Reservoir No. 2 Dam. The 1/2 PMF peak inflow of 490 cfs results in a routed outflow of 263 cfs with the existing spillway configuration. The test flood would peak 0.6 feet below the top of the dam. Replacing the missing stones in the spillway would raise the water level by 2 feet, and the test flood routed outflow of 350 cfs would overtop the dam by 0.1 feet. The flood routing through the reservoir was done in accordance with "Estimating Effect of Surcharge Storage on Maximum Probable Discharges" provided by the Corps of Engineers.

The existing spillway capacity was calculated to be about 410 cfs, or 156 percent of the test flood routed outflow. Replacing the missing stones would reduce spillway capacity to 328 cfs or 94 percent of the routed outflow.

5.5 Dam Failure Analysis

A dam failure analysis was made using the "Rule of Thumb" guidance provided by the Corps of Engineers. Failure was assumed with the water level at the top of the dam.

The dam breach would release up to 9,925 cfs into the stream below the dam. The flood waters would travel 400 feet downstream before overtopping Connecticut Route 69 by about 5 feet and flooding 7 residential homes up to 6 feet above sill elevation. The flood waters would also overtop Sherwood Drive by approximately 5 feet and flood 2 nearby homes up to 2 feet above sill elevation.

The flood waters would continue downstream about 0.9 miles in a steep channel before reaching a shopping plaza and other commercial establishments. The flood waters would overtop a large parking lot by about 2 feet. A twin 10' x 10' box culvert at Interstate 84 (I-84) would not be able to pass the flood flow so that water would back up, inundating several residential and commercial establishments along Reidville Drive and overtopping I-84. The flood waters would also reach several homes along Plank Road before discharging to the Mad River.

The maximum spillway discharge prior to the dam breach would be 410 cfs. This flow would overtop Connecticut Route 69 by 0.5 feet, flooding homes in this area up to 1.5 feet above sill level. Further downstream the flow would overtop Sherwood Drive by approximately 1 foot without flooding homes in this area. The spillway flow would overtop the parking lot at the shopping plaza but would not overtop I-84 or cause further damage.

The failure of Waterbury Reservoir No. 2 Dam could result in the loss of more than a few lives. Therefore, the dam is classified as "High" hazard potential.

EVALUATION OF STRUCTURAL STABILITY

SECTION 6

6.1 Visual Observations

The visual observations did not disclose any evidence of present or past structural instability. The future stability of the dam could be affected by:

1) Seepage at the toe;

2) Erosion of the crest and upstream slope;

3) Missing stones and deteriorated mortar in the spillway crest and downstream spillway wall;

4) Abandoned and inaccessible low level outlet or blowoff gates;

5) Voids in the stonework of the downstream masonry wall;

6) Debris and heavy overgrowth in the spillway discharge channel;

7) Discharge over the spillway into an unlined channel at the base of the downstream spillway wall;

8) Trees and vines growing on the downstream wall; and

9) Trees on the crest, the upstream slope and the downstream toe area.

6.2 Design and Construction Data

There was no information on the design or construction of the dam available for review.

6.3 Post-Construction Changes

The gate house was removed and a concrete slab poured over the top of the gate chamber around 1970, to eliminate vandalism.

6.4 Siesmic Stability

The dam is located in Seismic Zone 1 and in accordance with the recommended Phase I guidelines does not warrant seismic stability analysis.

ASSESSMENT, RECOMMENDATIONS, & REMEDIAL MEASURES
SECTION 7

7.1 Assessment

a. Condition

Based on the visual inspection, the dam appears to be in poor condition. The following features could affect the future integrity of the dam:

1) Seepage at the base of the downstream masonry wall and in the downstream toe area up to 100 feet downstream of the dam.

2) Erosion of the upstream slope and crest of the dam.

3) Missing stones in the spillway crest and missing or deteriorated mortar in the spillway crest and downstream spillway wall.

4) Abandoned and inaccessible low level outlet or blowoff gates.

5) Voids in the downstream masonry wall.

6) Debris and heavy overgrowth in the spillway discharge channel.

7) Discharge over the spillway into an unlined channel directly at the toe of the downstream wall.

8) Trees and vines growing out of the downstream wall.

9) Trees on the crest, upstream slope and downstream toe area.

An evaluation of the hydraulic and hydrologic features of the dam determined that the spillway is capable of passing 156 percent of the test flood routed outflow before overtopping the dam. Replacing the missing stones would reduce the spillway capacity to 94 percent of the test flood routed outflow.

b. Adequacy of Information

As no design or construction data was available for review, the assessment of the condition of the dam was based on the visual inspection, past performance history, and hydrologic and hydraulic calculations made for this Report.

c. Urgency

The recommendations described in Sections 7.2 and 7.3 should be carried out by the owner within one year of receipt of this Report.

7.2 Recommendations

The following items should be carried out under the direction of a qualified, registered engineer:

1) Investigate the significance of the seepage at the base of the downstream wall and in the toe area and recommend measures for monitoring the seepage and/or preventing piping of the foundation and embankment soils.

2) Remove trees growing on the upstream slope, crest, downstream wall and to within 20 feet of the downstream toe; and backfill root zones with appropriate soils.

3) Investigate the capacity of the spillway discharge channel and recommend measures to remove debris and to prevent scour and undermining of the downstream wall of the dam during periods of spillway discharge.

4) Investigate the condition of low level outlet or blowoff and recommend measures to restore outlet to usable condition.

5) Investigate the voids in the downstream masonry wall and recommend repair measures.

6) Clear spillway approach channel of brush, weeds and debris. Investigate means of stabilizing the spillway weir to prevent further

disintegration. Replacing the spillway stones is not recommended.

7) Restore the upstream slope and crest to the original grade, using appropriate soils, and install riprap protection on the upstream slope as required.

The owner should implement all recommendations made by the engineer based on the above investigations.

7.3 Remedial Measures

a. Operation and Maintenance

1) Clear brush and vines on the upstream slope, crest and downstream toe, and establish a regular mowing program.

2) Establish vegetative cover on all bare areas of the crest and upstream slope.

3) Institute a program of annual technical inspections by qualified, registered engineers.

4) Prepare a formal operation and maintenance manual for the dam and operating facilities.

5) Put into effect a formal warning system which should include monitoring of the dam during extremely heavy rains and procedures for notifying downstream authorities in the event of an emergency.

7.4 Alternatives

As the dam is no longer used for water supply, one of the alternatives to the preceeding recommendations is to remove the dam under the guidance of a qualified, registered engineer.

APPENDIX A

VISUAL CHECK LIST WITH COMMENTS

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT: Waterbury Reservoir No. 2 Dam

DATE: 7/28/80 TIME: 2:30 p.m. WEATHER: Partly Cloudy

W.S. ELEVATION: 743.3 U.S. N/A DN.S

	PARTY	DISCIPLINE
1.	Donald L. Smith, P.E. - Roald Haestad, Inc.	Civil/Hydrology
2.	Ronald G. Litke, P.E. - Roald Haestad, Inc.	Civil/Structural
3.	Gonzalo Castro, P.E., PhD - Geotechnical Engineers, Inc.	Geotechnical
4.	Frank Leathers, P.E. - Geotechnical Engineers, Inc.	Geotechnical
5.		
6.		

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam Embankment	RGL,DLS,GC,FL	Overgrown with brush,erosion to right of gate chamber.
2.	Outlet Works - Intake Channel & Structure		Not visible
3.	Outlet Works - Control Tower	RGL,DLS	Concrete slab poured over top of gate chamber.
4.	Outlet Works - Transition & Conduit	RGL,DLS	Cast iron pipe laid above ground.
5.	Outlet Works - Outlet Structure & Channel	RGL,DLS,GC,FL	No outlet structure, channel is natural streambed.
6.	Outlet Works - Spillway Weir, Approach and Discharge Channel	RGL,DLS,GC,FL	Stones missing at right end of weir, debris in discharge channel.
7.			
8.			
9.			
10.			
11.			

PERIODIC INSPECTION CHECK LIST

PROJECT: Waterbury Reservoir No. 2 Dam DATE: 7/28/80

PROJECT FEATURE: Dam Embankment NAME: RGL,DLS

DISCIPLINE: Civil Engineers and Geotechnical Engineers NAME: GC,FL

AREA ELEVATION	CONDITIONS
DAM EMBANKMENT	
CREST ELEVATION	747
CURRENT POOL ELEVATION	743.3
MAXIMUM IMPOUNDMENT TO DATE	Unknown
SURFACE CRACKS	None observed
PAVEMENT CONDITION	N/A
MOVEMENT OR SETTLEMENT OF CREST	None observed
LATERAL MOVEMENT	None observed
VERTICAL ALIGNMENT	Depression in crest due to erosion to right of gate chamber
HORIZONTAL ALIGNMENT	Too irregular to judge
CONDITION AT ABUTMENT AND AT CONCRETE STRUCTURES	Good
INDICATIONS OF MOVEMENT OF STRUCTURAL ITEMS ON SLOPES	None observed
TRESPASSING ON SLOPES	Well-worn footpaths on crest and upstream slopes.
VEGETATION ON SLOPES	Trees, brush and vines on D.S. wall and toe area. Brush and weed on crest and U.S. slope.
SLOUGHING OR EROSION OF SLOPES OR ABUTMENTS	Severe erosion of upstream slope and crest to right of gate chamber.
ROCK SLOPE PROTECTION - RIPRAP FAILURES	Riprap overgrown with brush, missing in some areas of upstream slope.
UNUSUAL MOVEMENT OR CRACKING AT OR NEAR TOES	None observed
EMBANKMENT OR DOWNSTREAM SEEPAGE	Seepage at toe of downstream wall and up to 100' downstream of wall.
PIPING OR BOILS	Several open seepage channels extending back under downstream wall.
FOUNDATION DRAINAGE FEATURES	None observed
TOE DRAINS	None observed
INSTRUMENTATION SYSTEM	None observed.

PERIODIC INSPECTION CHECK LIST

PROJECT: Waterbury Reservoir No. 2 Dam DATE: 7/28/80

PROJECT FEATURE: Outlet Works - Intake Channel and Structure NAME: RGL,DLS

DISCIPLINE: Civil Engineers, Geotechnical Engineers NAME: GC,FL

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
A. APPROACH CHANNEL:	Not visible
SLOPE CONDITIONS	
BOTTOM CONDITIONS	
ROCK SLIDES OR FALLS	
LOG BOOM	
DEBRIS	
CONDITION OF CONCRETE LINING	
DRAINS OR WEEP HOLES	
B. INTAKE STRUCTURE:	Not visible
CONDITION OF CONCRETE	
STOP LOGS AND SLOTS	

PERIODIC INSPECTION CHECK LIST

PROJECT: Waterbury Reservoir No. 2 Dam DATE: 7/28/80

PROJECT FEATURE: Outlet Works - Control Tower NAME: RGL,DLS

DISCIPLINE: Civil Engineer NAME:

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
A. CONCRETE AND STRUCTURAL:	
GENERAL CONDITION	Gate house has been removed and concrete slab poured over top of chamber, making gates inaccessible.
CONDITION OF JOINTS	Open joints in stone masonry walls.
SPALLING	None observed
VISIBLE REINFORCING	None observed
RUSTING OR STAINING OF CONCRETE	N/A
ANY SEEPAGE OR EFFLORESCENCE	Could not be observed
JOINT ALIGNMENT	No joints observed
UNUSUAL SEEPAGE OR LEAKS IN GATE CHAMBER	Could not be observed. Concrete slab poured over top of chamber to deter vandalism.
CRACKS	None observed
RUSTING OR CORROSION OF STEEL	N/A
B. MECHANICAL AND ELECTRICAL:	
AIR VENTS	N/A
FLOAT WELLS	N/A
CRANE HOIST	N/A
ELEVATOR	N/A
HYDRAULIC SYSTEM	N/A
SERVICE GATES	Could not be observed
EMERGENCY GATES	N/A
LIGHTNING PROTECTION SYSTEM	N/A
EMERGENCY POWER SYSTEM	N/A
WIRING AND LIGHTING SYSTEM IN GATE CHAMBER	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT: Waterbury Reservoir No. 2 Dam DATE: 7/28/80

PROJECT FEATURE: Outlet Works - Transition and Conduit NAME: RGL

DISCIPLINE: Civil Engineers NAME: DLS

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	Outlet works conduit consists of cast iron pipe laid above ground discharging approximately 100' downstream.
GENERAL CONDITION OF CONCRETE	
RUST OR STAINING ON CONCRETE	
SPALLING	
EROSION OR CAVITATION	
CRACKING	
ALIGNMENT OF MONOLITHS	
ALIGNMENT OF JOINTS	
NUMBERING OF MONOLITHS	

PERIODIC INSPECTION CHECK LIST

PROJECT: Waterbury Reservoir No. 2 Dam DATE: 7/28/80

PROJECT FEATURE: Outlet Works - Outlet Structure and Outlet Channel NAME: RGL,DLS

DISCIPLINE: Civil Engineers, Geotechnical Engineers NAME: GC,FL

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL GENERAL CONDITION OF CONCRETE	Outlet structure consists of cast iron pipe laid on top of the ground and discharging approximately 100' downstream
RUST OR STAINING	N/A
SPALLING	N/A
EROSION OR CAVITATION	N/A
VISIBLE REINFORCING	N/A
ANY SEEPAGE OR EFFLORESCENCE	N/A
CONDITION AT JOINTS	N/A
DRAIN HOLES	N/A
CHANNEL	Natural channel bottom is sand & gravel, with covering of decayed vegetation.
LOOSE ROCK OR TREES OVERHANGING CHANNEL	Trees and brush over channel. Some branches have fallen across channel.
CONDITION OF DISCHARGE CHANNEL	Fair

PERIODIC INSPECTION CHECK LIST

PROJECT: Waterbury Reservoir No. 2 Dam DATE: 7/28/80

PROJECT FEATURE: Outlet Works - Spillway Weir, Approach & Discharge Channel NAME: RGL,DLS

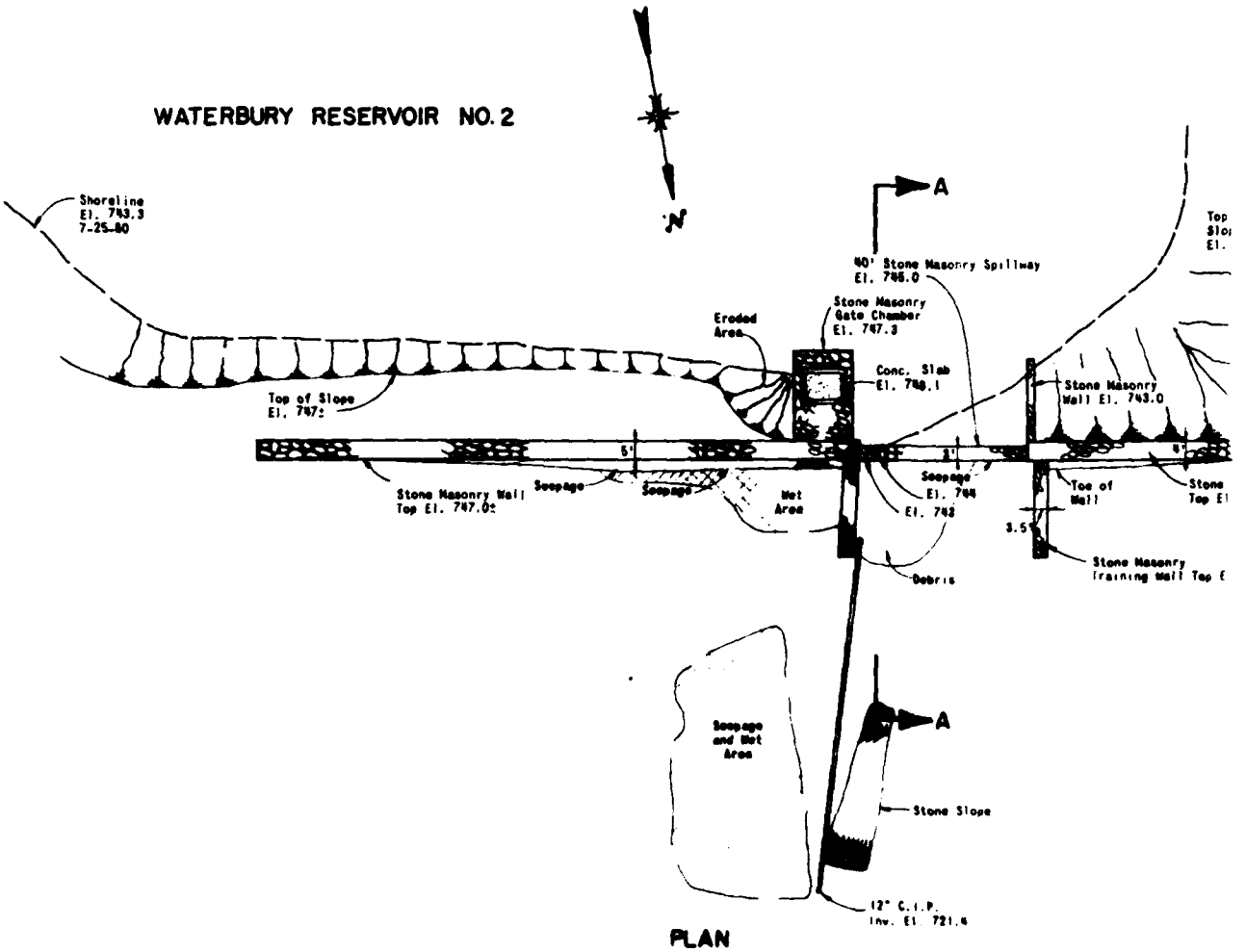
DISCIPLINE: Civil Engineers, Geotechnical Engineers NAME: GC,FL

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
A. APPROACH CHANNEL:	
GENERAL CONDITION	Loose and open stone work in right training wall (wall of gate chamber)
LOOSE ROCK OVERHANGING CHANNEL	None
TREES OVERHANGING CHANNEL	None
FLOOR OF APPROACH CHANNEL	Not visible underwater
B. WEIR AND TRAINING WALLS:	
GENERAL CONDITION OF CONCRETE	Weir constructed of stone masonry. Stones missing at right end.
RUST OR STAINING	N/A
SPALLING	N/A
ANY VISIBLE REINFORCING	N/A
ANY SEEPAGE OR EFFLORESCENCE	Seepage observed at downstream toe of stone masonry wall.
DRAIN HOLES	None observed. Drainage through voids and cracks in mortar of stone walls.
C. DISCHARGE CHANNEL:	
GENERAL CONDITION	Fair
LOOSE ROCK OVERHANGING CHANNEL	None
TREES OVERHANGING CHANNEL	Numerous large trees and brush along channel.
FLOOR OF CHANNEL	Natural channel. Sand and cobble bottom with layer of decayed vegetation.
OTHER OBSTRUCTIONS	Some branches have fallen across the channel, also timber and miscellaneous debris block right side of channel.

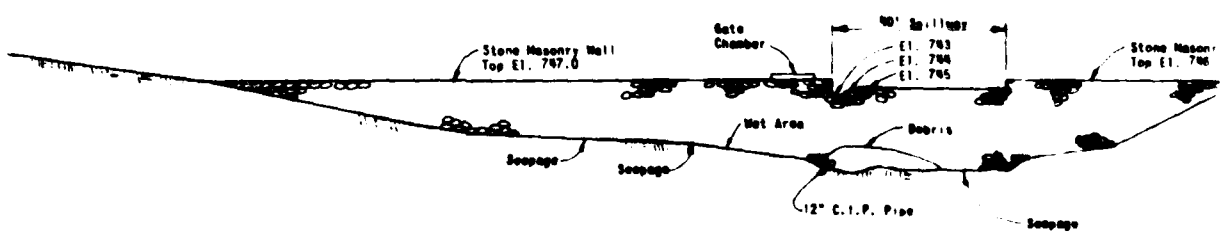
APPENDIX B

ENGINEERING DATA

WATERBURY RESERVOIR NO. 2

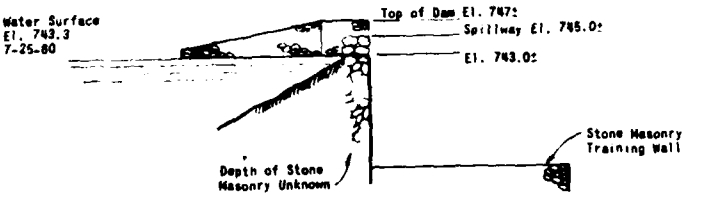


PLAN
Scale 1"=40'



ELEVATION
Scale 1"=40'

FIGURE 2



SECTION A-A
Scale 1"= 20'

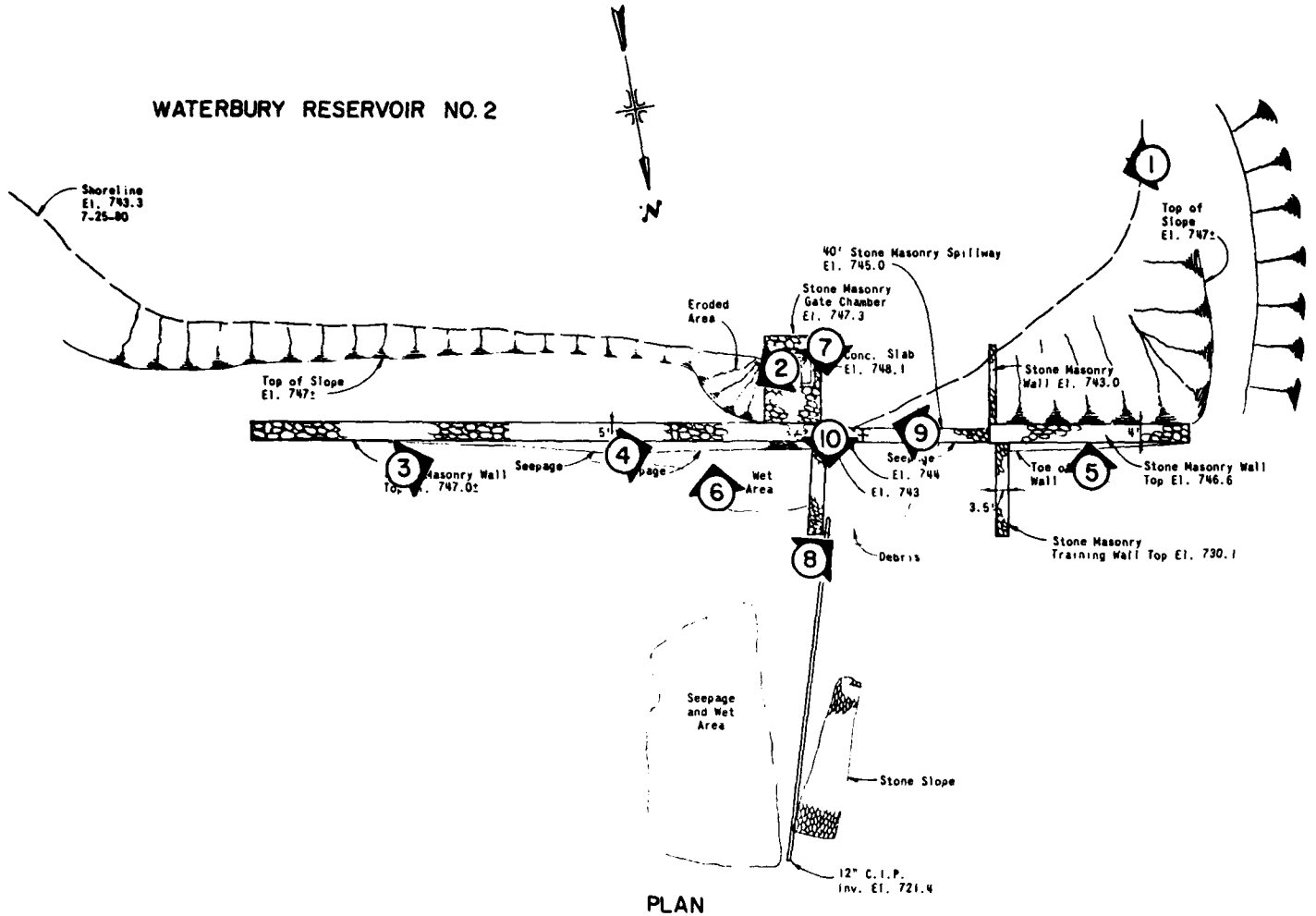
2

ROALD HAESTAD, INC CONSULTING ENGINEERS WATERBURY, CONNECTICUT			US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS			
WATERBURY RESERVOIR NO. 2			
DRAWN	CHECKED	APPROVED	SCALES AS NOTED
JRS	ROL	RH	DATE SEPT 1980 PAGE 0-1

APPENDIX C

PHOTOGRAPHS

FIGURE 3



Denotes photo number and direction in which photo was taken

ROALD HAESTAD, INC CONSULTING ENGINEERS WATERBURY, CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

PHOTO LOCATION PLAN

WATERBURY RESERVOIR NO 2 DAM

PROSPECT, CONNECTICUT

DRAWN	CHECKED	APPROVED	SCALES AS NOTED
JRS	RGL	RH	DATE SEPT 1980 PAGE C-1

PHOTO NO. 1

UPSTREAM SLOPE FROM LEFT ABUTMENT.
NOTE RIPRAP SLOPE PROTECTION, WEEDS AND GATE CHAMBER.

PHOTO NO. 2

EROSION OF UPSTREAM SLOPE AND CREST
TO THE RIGHT OF THE GATE CHAMBER.

US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	WATERBURY RES. NO. 2 DAM TURKEY HILL BROOK PROSPECT, CONNECTICUT CT 00304 28 JULY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 3

DOWNSTREAM STONE MASONRY WALL.
NOTE VINES ON WALL
AND DOWNSTREAM VEGETATION.

PHOTO NO. 4

TREE GROWING OUT
OF DOWNSTREAM WALL.

U.S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	WATERBURY RES. NO. 2 DAM TURKEY HILL BROOK PROSPECT, CONNECTICUT CT 00304 28 JULY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 3

DOWNSTREAM STONE MASONRY WALL.
NOTE VINES ON WALL
AND DOWNSTREAM VEGETATION.

PHOTO NO. 4

TREE GROWING OUT
OF DOWNSTREAM WALL.

U.S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	WATERBURY RES. NO. 2 DAM TURKEY HILL BROOK PROSPECT, CONNECTICUT CT 00304 28 JULY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 5

VOID IN DOWNSTREAM WALL
TO LEFT OF SPILLWAY.

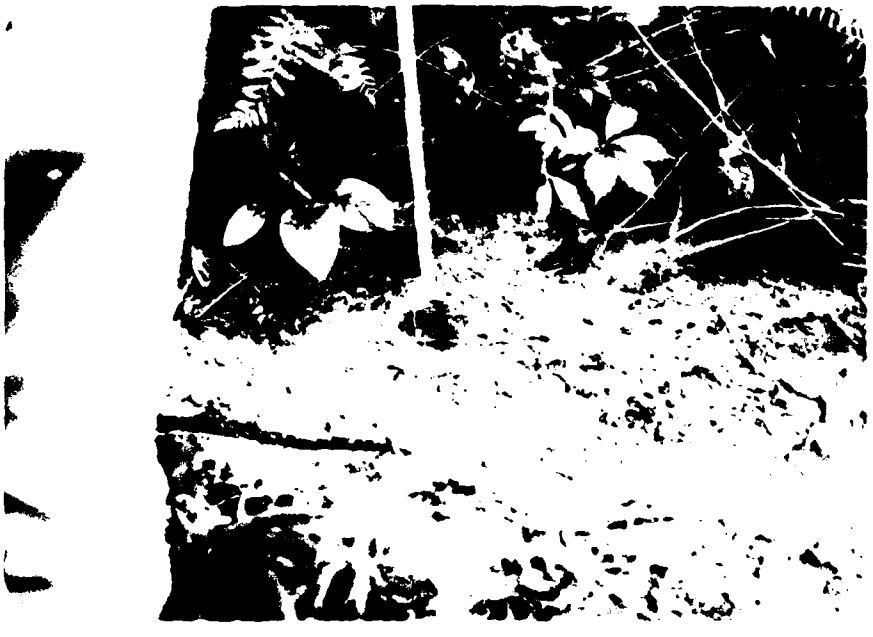


PHOTO NO. 6

SEEPAGE AT BASE OF DOWNSTREAM WALL. NOTE OPEN
SEEPAGE CHANNEL (DIRECTLY BELOW RULE) EXTENDING UNDER WALL.

U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	WATERBURY RES. NO. 2 (AM) TURKEY HILL BROOK PROJECT, CONNECTICUT CT 00304 28 JULY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 7

MISSING STONES AT
RIGHT END OF
OVERFLOW SPILLWAY.

PHOTO NO. 8

DOWNSTREAM FACE
OF SPILLWAY. NOTE VOIDS
BETWEEN STONES.

U.S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	WATERBURY RES. NO. 2 DAM TURKEY HILL BROOK PROSPECT, CONNECTICUT CT 00304 28 JULY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

PHOTO NO. 9

RIGHT SPILLWAY TRAINING WALL AND GATE CHAMBER. NOTE VOIDS IN STONE WORK AND CONCRETE SLAB OVER TOP OF CHAMBER

PHOTO NO. 10

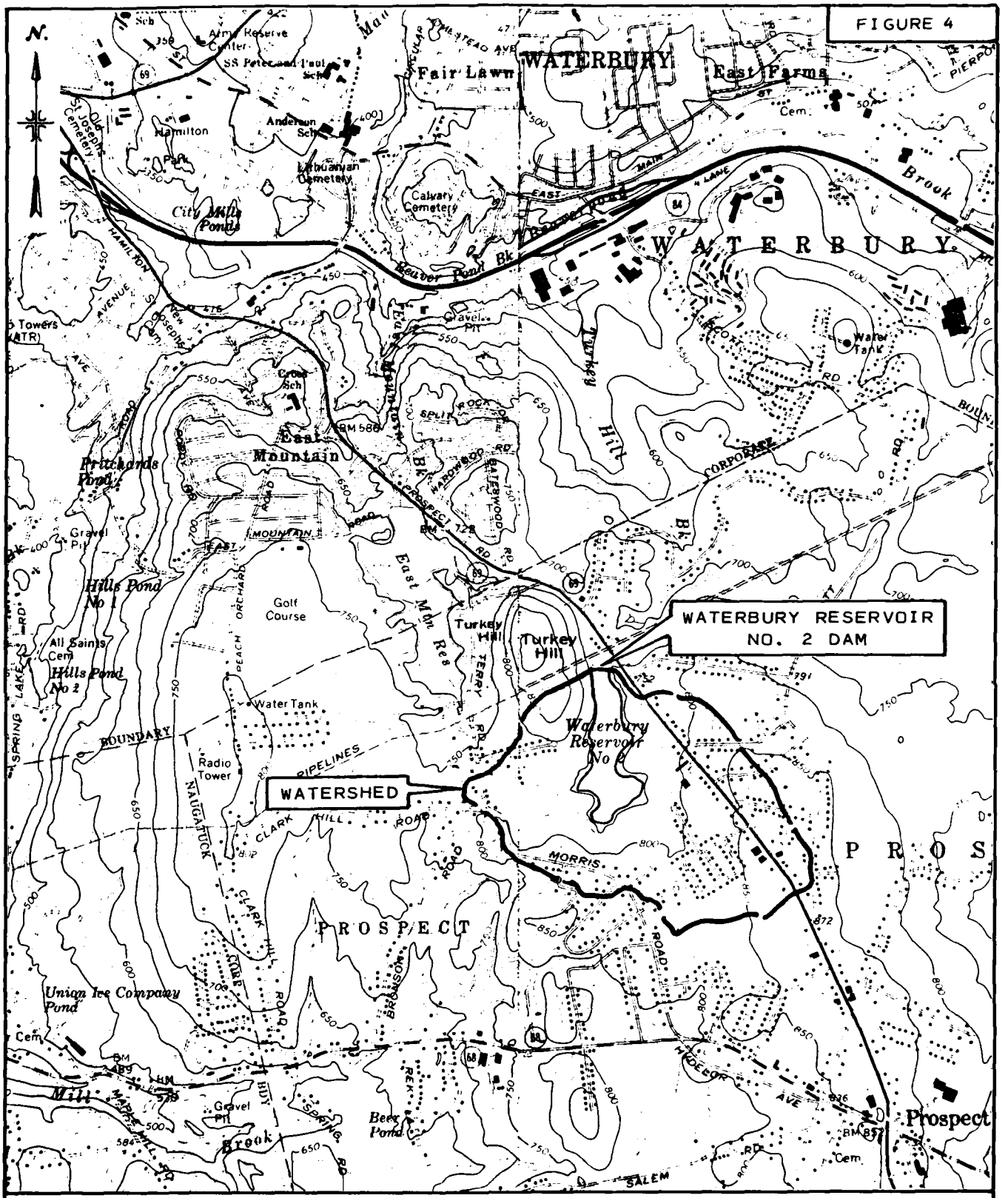
SPILLWAY DISCHARGE CHANNEL AT RIGHT TRAINING WALL. NOTE DEBRIS AND 12-INCH CAST IRON OUTLET PIPE

U.S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	WATERBURY RES. NO. 2 DAM TURKEY HILL BROOK PROSPECT, CONNECTICUT CT 00304 28 JULY '80
ROALD HAESTAD, INC. CONSULTING ENGINEERS WATERBURY, CONNECTICUT		

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

FIGURE 4



WATERSHED MAP

WATERBURY RESERVOIR NO. 2 DAM
PROSPECT, CONNECTICUT

SCALE: 1" = 2000'

WATERBURY QUADRANGLE 1972
SOUTHINGTON QUADRANGLE 1972

ROALD HAESTAD, INC.

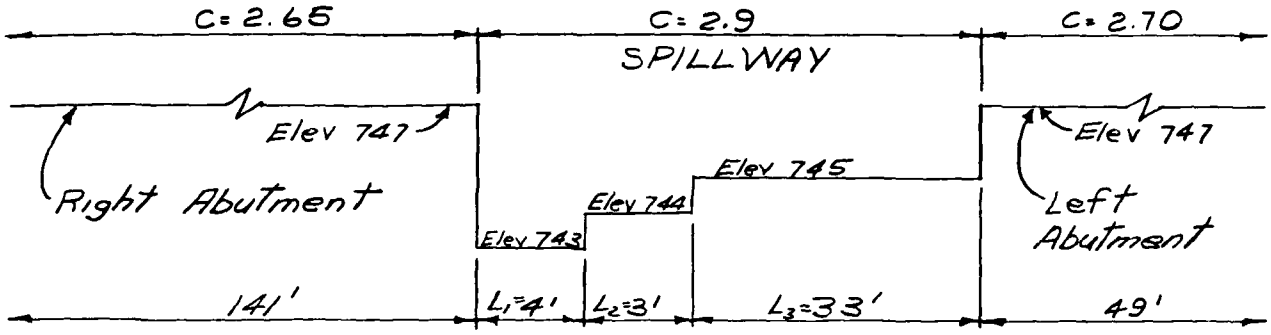
BY SAL DATE 8/19/80 **ROALD HAESTAD, INC.** SHEET NO 1 OF 19

CONSULTING ENGINEERS

CKD BY DLS DATE 8/21/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-025

SUBJECT WATERBURY RES. No 2 - Project Discharge Capacity

Spillway and Dam profile: (Not to scale)



Discharge Coefficients: 1) Spillway C = 2.9
3) Left Abutment C = 2.70
4) Right Abutment C = 2.65

Spillway Capacity @ top of dam:

$Q = CL_1H^{3/2} + CL_2H^{3/2} + CL_3H^{3/2}$

$= 2.9(4)(4)^{1.5} + 2.9(3)(3)^{1.5} + 2.9(33)(2)^{1.5}$

$= 92.8 + 45.2 + 270.7$

$= 408.7$ use 409 cfs

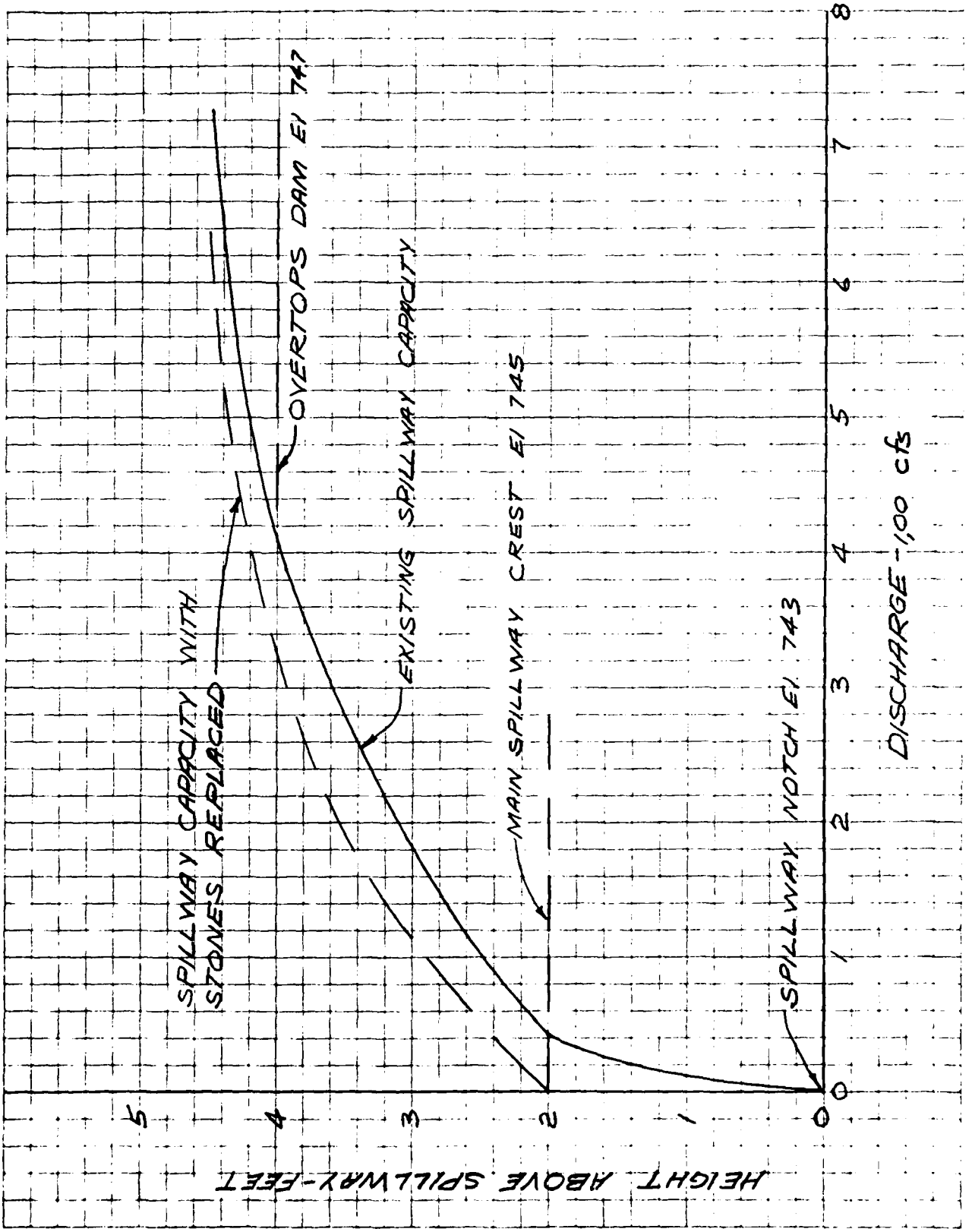
Height Above Spillway (ft)	Total Spillway Disch. Capacity (cfs)	Right Abutment Disch. Capacity (cfs)	Left Abutm. Disch Capac. (cfs)	Total Disch. Capacity (cfs)
0	0	0	0	0
1	12	0	0	12
2	42	0	0	42
3	181	0	0	181
4	409	0	0	409
4.5	546	132	47	725
5	697	374	132	1,203

BY SAL DATE 8/20/80 **ROALD HAESTAD, INC.** SHEET NO 2 OF 19

CONSULTING ENGINEERS

CKD BY DLS DATE 8/21/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-025

SUBJECT WATERBURY RES. No 2 - Project Discharge Capacity Curve



BY SAL DATE 8/20/80 **ROALD HAESTAD, INC.** SHEET NO 3 OF 19

CONSULTING ENGINEERS

CKD BY DLS DATE 8/21/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-025

SUBJECT WATERBURY RES. No. 2 - Surcharge Storage Capacity

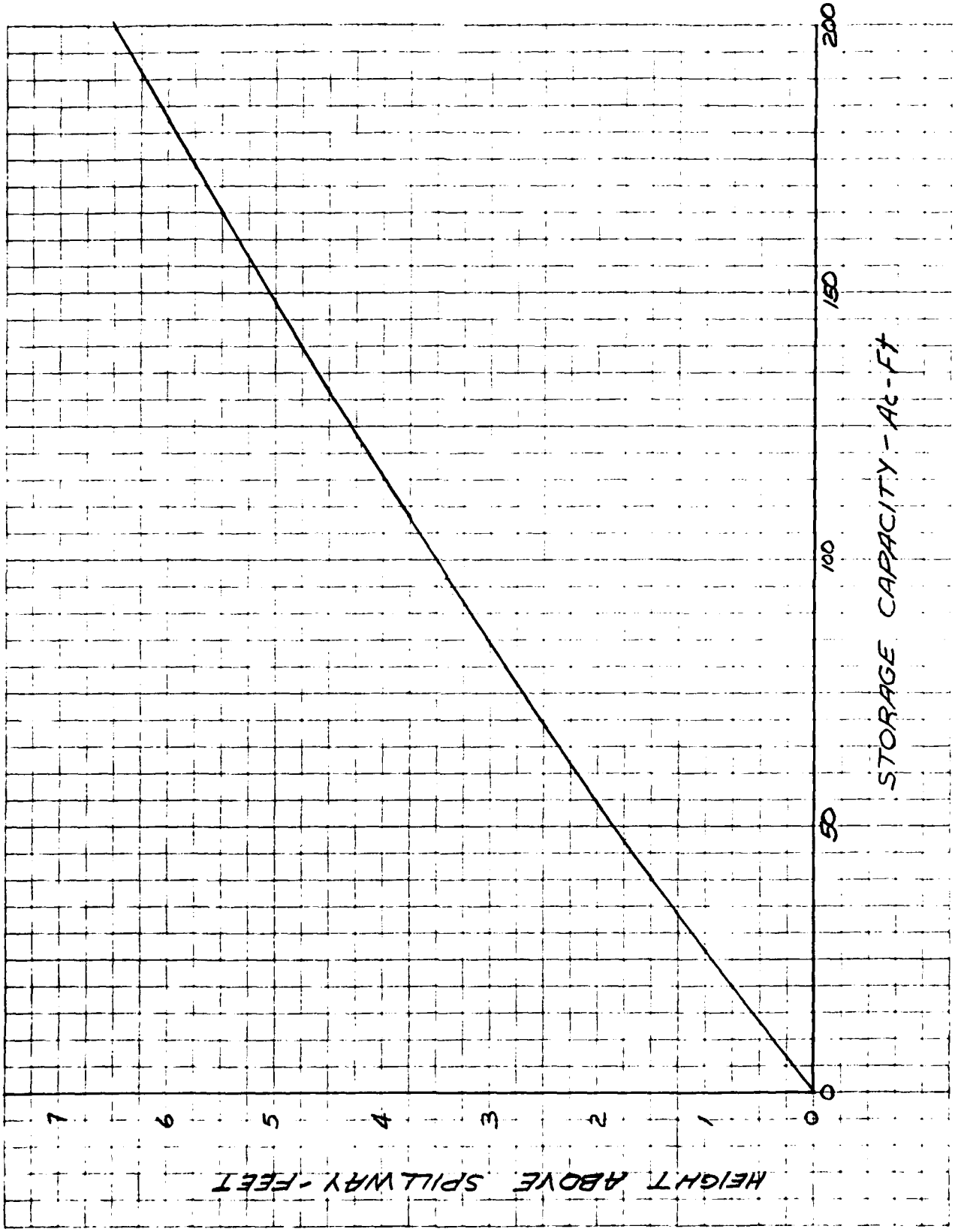
Height Above Spillway (Feet)	Surface Area (Acres)	Average Surface Area (Acres)	Storage Volume (Acre-Feet)
0	25.7		0
		26.5	
1	27.3		26.5
		28.05	
2	28.8		54.6
		29.6	
3	30.4		84.2
		31.2	
4	32.0		115.4
		32.8	
5	33.6		148.2
		34.35	
6	35.1		182.5
		35.9	
7	36.7		218.4

BY SAL DATE 8/20/80 **ROALD HAESTAD, INC.** SHEET NO 4 OF 19

CONSULTING ENGINEERS

CKD BY DHS DATE 8/21/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-025

SUBJECT WATERBURY RES. No. 2 - Surcharge Storage Capacity Curve



Test Flood = 1/2 PMF

Drainage Area = 294 acres = 0.46 sq. mi.

From Corps of Eng. chart for "Rolling" Terrain

MPF = 2,125 cfs/sq. mi. (2.0 sq. mi. Minimum)

PMF = 2,125 cfs/sq mi x 0.46 sq mi = 977.5 cfs

1/2 PMF = 1/2 (977.5 cfs) = 488.75 use 490 cfs

Q_{P1} = 490 cfs

H_1 = 4.2 feet above spillway, from Discharge Capacity Curve

$STOR_1$ = 122 ac-ft, from Storage Capacity curve

= 5.0" runoff from 0.46 sq. mi.

Maximum Probable Flood Runoff in New England equals approx. 19". Therefore 1/2 PMF equals approx. 1/2(19") = 9.5"

$Q_{P2} = Q_{P1}(1 - STOR_1/9.5) = 490\ cfs\ (1 - 5.0"/9.5) = 232\ cfs$

H_2 = 3.3 feet $STOR_2$ = 94 ac-ft

$STOR_{AVE} = (STOR_1 + STOR_2)/2 = (122+94)/2 = 108$ ac-ft
= 4.4" runoff

$Q_{P3} = Q_{P1}(1 - STOR_{AVE}/9.5) = 490 cfs\ (1 - 4.4/9.5) = 263$ cfs

H_3 = 3.4 feet

Spillway Capacity @ top of dam:

$$Q = CL_1H^{3/2} + CL_2H^{3/2} + CL_3H^{3/2}$$
$$Q = 2.9(4)(4)^{1.5} + 2.9(3)(3)^{1.5} + 2.9(33)(2)^{1.5}$$
$$Q = 408.7 \text{ use } 409 \text{ cfs}$$

% of 1/2 PMF = (409/263) x 100 = 156% of 1/2 PMF

Note: Assume the missing spillway stones are replaced. The effect of this action on the Test Flood routing and maximum spillway capacity was investigated.

Spillway Capacity @ top of dam:

$Q = C L H^{3/2} = 2.9(40)(2)^{3/2}$

$Q = 328$ cfs

Test Flood Routing:

$Q_{P1} = 490$ cfs (See Computation Sheet 5 of 19)

$H_1 = 2.3$ feet above restored spillway

$STOR_1 = 72$ Ac-Ft = 2.9" runoff

$Q_{P2} = Q_{P1}(1 - STOR_1/9.5) = 490\text{ cfs}(1 - 2.9/9.5) = 340$ cfs

$H_2 = 2.0$ ft $\quad STOR_2 = 60$ Ac-Ft

$STOR_{AVE} = (STOR_1 + STOR_2)/2 = (72+60)/2 = 66$ Ac-Ft
= 2.7" runoff

$Q_{P3} = Q_{P1}(1 - STOR_{AVE}/9.5) = 490\text{ cfs}(1 - 2.7/9.5) = 351$ cfs
use 350 cfs

$H_3 = 2.1$ ft

% of 1/2 PMF $= (328/350) \times 100 = 94\%$ of 1/2 PMF

S = Storage at time of failure with water level at top of dam

S = Storage at spillway level + Freeboard storage

S = (Surface Area x Estimated Ave. depth) + (From surcharge storage capacity curve)

S = (25.7 acres x 8 feet) + (115.4 acre-feet)

S = 321 acre-feet

Q_{pl} = Peak Failure Outflow = $8/27\ W_b \sqrt{g}\ Y_o^{3/2}$

W_b = Breach Width - 40% of dam length across river at mid height = 0.4(166') = 66.4' use 66'

Y_o = Total height from river bed to pool level at time of failure = 20'

$Q_{pl} = 8/27\,(66)(\sqrt{32.2})(20)^{3/2} = 9,925.3$ use 9,925 cfs

BY SAL DATE 9/17/80 ROALD HAESTAD, INC. SHEET NO 7 OF 19

CKD BY DLS DATE 9/17/80 CONSULTING ENGINEERS JOB NO 49-025

SUBJECT WATERBURY RESERVOIR NO. 2-FLOOD ROUTING AT TOP OF DAM

SECTION NUMBER 1

STORAGE CAPACITY WITHIN REACH

HEIGHT (FEET)	SURFACE AREA (ACRES)	STORAGE VOLUME (ACRE-FEET)
1.0	.12	.1
2.0	.24	.2
3.0	.36	.5
4.0	.48	1.0
5.0	.60	1.5
6.0	.72	2.2
7.0	.84	2.9
8.0	.96	3.8
9.0	1.08	4.9
10.0	1.20	6.0
11.0	1.36	7.3
12.0	1.52	8.7
13.0	1.68	10.3
14.0	1.84	12.1
15.0	2.00	14.0
16.0	2.16	16.1
17.0	2.32	18.3
18.0	2.48	20.7
19.0	2.64	23.3
20.0	2.80	26.0

STORAGE CAPACITY CALCULATED FROM SURFACE AREAS AT KNOWN ELEVATIONS.

BY SAL DATE 9/17/80 ROALD HAESTAD, INC. SHEET NO 8 OF 19

CKD BY DLS DATE 9/17/80 CONSULTING ENGINEERS JOB NO 49-025

SUBJECT WATERBURY RESERVOIR NO.2-FLOOD ROUTING AT TOP OF DAM

SECTION NUMBER 1

ROUTE-69

HEIGHT ABOVE INVERT (FEET)	DISCHARGE CAPACITY CONDUIT (CFS)	SPILLWAY (CFS)	TOTAL (CFS)
1.0	14	0	14
2.0	28	0	28
3.0	59	0	59
4.0	90	0	90
5.0	123	0	123
6.0	155	0	155
7.0	183	450	633
8.0	210	1473	1683
9.0	230	3129	3359
10.0	250	5438	5688
11.0	268	8372	8640
12.0	285	11812	12097
13.0	300	15774	16074
14.0	315	20193	20508
15.0	330	25108	25438
16.0	345	30467	30812
17.0	358	36315	36672
18.0	370	42603	42973

STORAGE AT TIME OF FAILURE=S= 320 AC. FT.
LENGTH OF REACH=L= 400 FT.

INFLOW INTO REACH=QP1= 9925 CFS
HEIGHT ABOVE CONDUIT INVERT=H1= 11.4 FT.
STORAGE IN REACH=V1= 7.8 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)= 9683 CFS
TRIAL HEIGHT ABOVE CONDUIT INVERT=H(TRIAL)= 11.3 FT.
TRIAL STORAGE IN REACH=V(TRIAL)= 7.7 AC. FT.

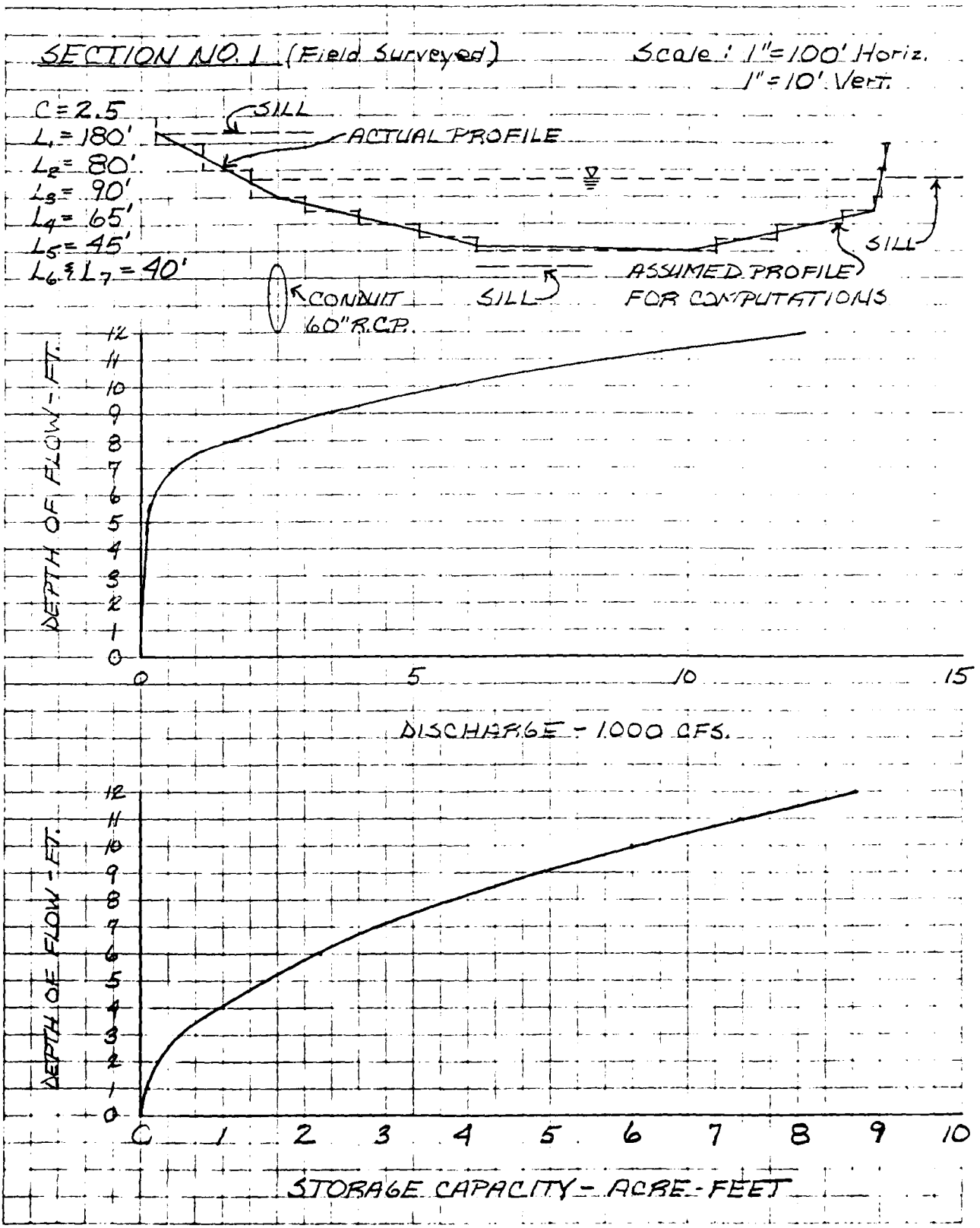
REACH OUTFLOW=QP2= 9684 CFS
HEIGHT ABOVE CONDUIT INVERT=H2= 11.3 FT.

BY ... DATE 8/20/80 **ROALD HAESTAD, INC.** SHEET NO 9 OF 19

CONSULTING ENGINEERS

CKD BY DLS DATE 8/21/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 79-025

SUBJECT WATERBURY RESERVOIR NO. 2 - FLOOD ROUTING



BY SAL DATE 9/17/80 ROALD HAESTAD, INC. SHEET NO 10 OF 19

CKD BY DLS DATE 9/17/80 CONSULTING ENGINEERS JOB NO 49-025

SUBJECT WATERBURY RESERVOIR NO. 2-FLOOD ROUTING AT TOP OF DAM

SECTION NUMBER 2A

MAIN CHANNEL

H	W	A	R	S	V	Q
1.0	23	20	.85	.0625	4.17	83
2.0	28	45	1.60	.0625	6.36	287
3.0	32	74	2.29	.0625	8.06	600
4.0	34	105	3.05	.0625	9.78	1030
5.0	36	136	3.74	.0625	11.18	1525
6.0	38	167	4.35	.0625	12.37	2071
7.0	40	198	4.90	.0625	13.40	2658
8.0	42	229	5.40	.0625	14.29	3278
9.0	44	260	5.85	.0625	15.08	3928
10.0	46	291	6.27	.0625	15.79	4601

MANNING COEFFICIENT=N=.0800

BY SAL DATE 9/17/80 ROALD HAESTAD, INC. SHEET NO 11 OF 19

CKD BY DLS DATE 9/17/80 CONSULTING ENGINEERS JOB NO 49-025

SUBJECT WATERBURY RESERVOIR NO. 2-FLOOD ROUTING AT TOP OF DAM

SECTION NUMBER 2B

LEFT OVERBANK

H	W	A	R	S	V	Q
4.0	22	11	.52	.0625	3.01	34
5.0	42	42	1.00	.0625	4.63	192
6.0	60	90	1.50	.0625	6.08	549
7.0	77	155	2.01	.0625	7.40	1148
8.0	94	236	2.51	.0625	8.57	2024
9.0	108	332	3.06	.0625	9.80	3249
10.0	122	440	3.60	.0625	10.91	4801

MANNING COEFFICIENT=N=.0800

BY SAL DATE 9/17/80 ROALD HAESTAD, INC. SHEET NO 12 OF 19

CKD BY DLS DATE 9/17/80 CONSULTING ENGINEERS JOB NO 49-025

SUBJECT WATERBURY RESERVOIR NO. 2-FLOOD ROUTING AT TOP OF DAM

SECTION NUMBER 2C

RIGHT OVERBANK

H	W	A	R	S	V	Q
4.0	39	21	.53	.0625	3.06	63
5.0	74	76	1.02	.0625	4.71	356
6.0	89	155	1.73	.0625	6.70	1036
7.0	104	248	2.38	.0625	8.27	2048
8.0	119	355	2.97	.0625	9.60	3406
9.0	134	476	3.54	.0625	10.79	5132
10.0	149	611	4.09	.0625	11.88	7252

MANNING COEFFICIENT=N=.0800

SUBJECT WATERBURY RESERVOIR NO. 2-FLOOD ROUTING AT TOP OF DAM

SECTION NUMBER 2

SHERWOOD DRIVE

	AREA				DISCHARGE			
H	A	B	C	TOTAL	A	B	C	TOTAL
1.0	20	0	0	20	83	0	0	83
2.0	45	0	0	45	287	0	0	287
3.0	74			75	600			600
4.0	105	11	21	137	1030	34	63	1128
5.0	136	42	76	254	1525	192	356	2073
6.0	167	90	155	412	2071	549	1036	3655
7.0	198	155	248	601	2658	1148	2048	5853
8.0	229	236	355	820	3278	2024	3406	8708
9.0	260	332	476	1068	3928	3249	5132	12309
10.0	291	440	611	1342	4601	4801	7252	16654

STORAGE AT TIME OF FAILURE=S= 320 AC. FT.
LENGTH OF REACH=L= 1500 FT.

INFLOW INTO REACH=QP1= 9684 CFS
DEPTH OF FLOW=H1= 8.3 FT.
CROSS SECTIONAL AREA=A1= 890 SQ. FT.
STORAGE IN REACH=V1= 30.6 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)= 8757 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 8.0 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 824 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)= 28.4 AC. FT.

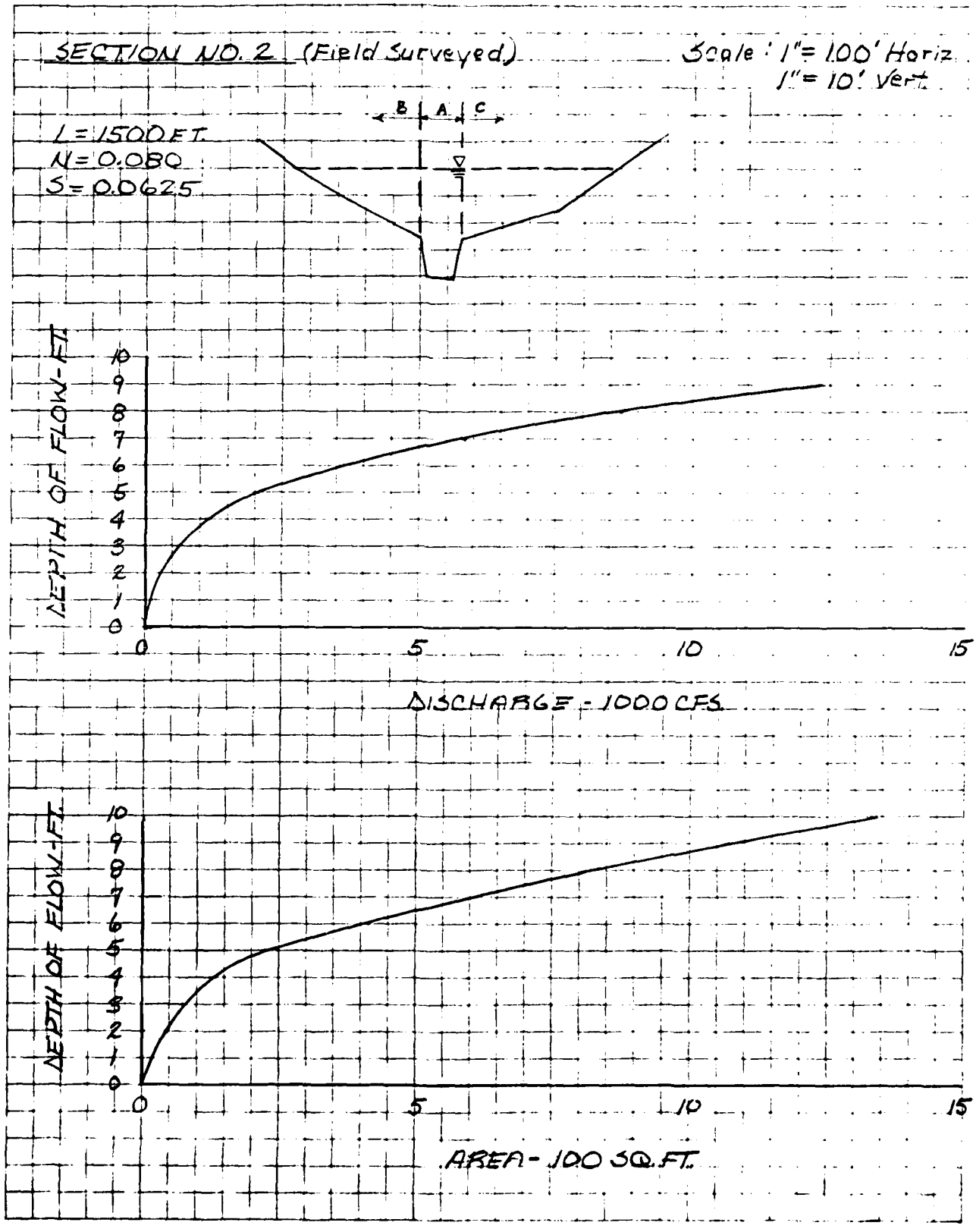
REACH OUTFLOW=QP2= 8791 CFS
DEPTH OF FLOW=H2= 8.0 FT.

BY LEG DATE 8/20/80 **ROALD HAESTAD, INC.** SHEET NO 14 OF 19

CONSULTING ENGINEERS

CKD BY DLS DATE 8/21/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-025

SUBJECT WATERBURY RESERVOIR NO. 2 - FLOOD ROUTING



SECTION NUMBER 3

TOTAL SECTION

H	W	A	R	S	V	Q
1.0	27	14	.50	.0516	2.12	29
2.0	54	54	1.00	.0516	3.37	182
3.0	81	122	1.50	.0516	4.42	536
4.0	108	216	1.99	.0516	5.35	1155
5.0	135	338	2.49	.0516	6.21	2095
6.0	162	486	2.99	.0516	7.01	3406
7.0	190	662	3.49	.0516	7.77	5138
8.0	217	864	3.99	.0516	8.49	7335
9.0	244	1094	4.49	.0516	9.18	10042
10.0	271	1350	4.99	.0516	9.85	13300
11.0	286	1628	5.68	.0516	10.75	17500
12.0	302	1921	6.36	.0516	11.59	22261
13.0	318	2230	7.02	.0516	12.38	27594
14.0	333	2554	7.66	.0516	13.12	33511
15.0	349	2894	8.29	.0516	13.83	40024
16.0	365	3249	8.91	.0516	14.51	47146
17.0	380	3620	9.52	.0516	15.16	54892
18.0	396	4006	10.12	.0516	15.79	63274
19.0	411	4408	10.71	.0516	16.40	72309
20.0	427	4825	11.30	.0516	17.00	82009

MANNING COEFFICIENT=N=.1000
STORAGE AT TIME OF FAILURE=S= 320 AC. FT.
LENGTH OF REACH=L= 5000 FT.

INFLOW INTO REACH=QP1= 8791 CFS
DEPTH OF FLOW=H1= 8.5 FT.
CROSS SECTIONAL AREA=A1= 987 SQ. FT.
STORAGE IN REACH=V1= 113.3 AC. FT.

TRIAL REACH OUTFLOW=QP(TRIAL)= 5677 CFS
TRIAL DEPTH OF FLOW=H(TRIAL)= 7.2 FT.
TRIAL CROSS SECTIONAL AREA=A(TRIAL)= 711 SQ. FT.
TRIAL STORAGE IN REACH=V(TRIAL)= 81.6 AC. FT.

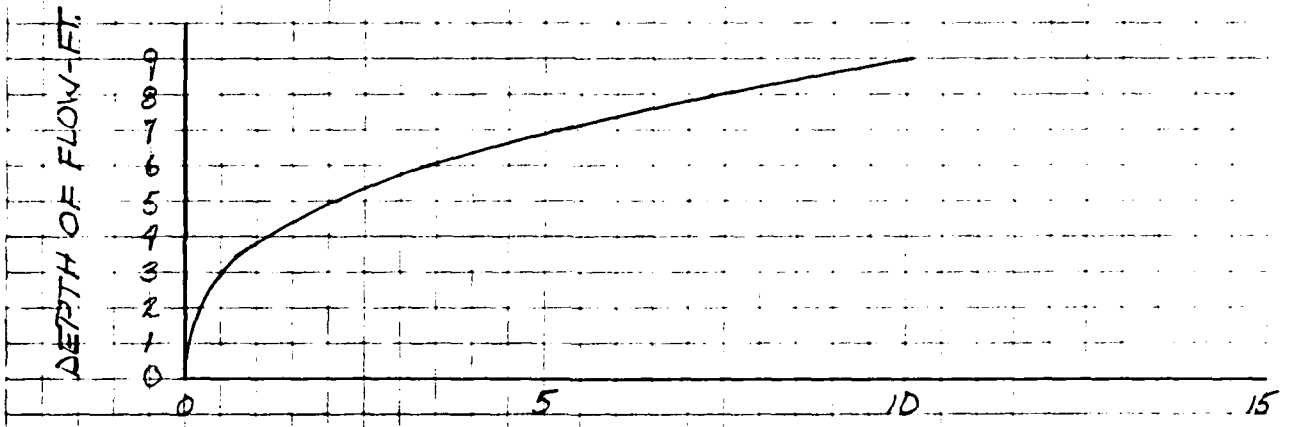
REACH OUTFLOW=QP2= 6113 CFS
DEPTH OF FLOW=H2= 7.4 FT.

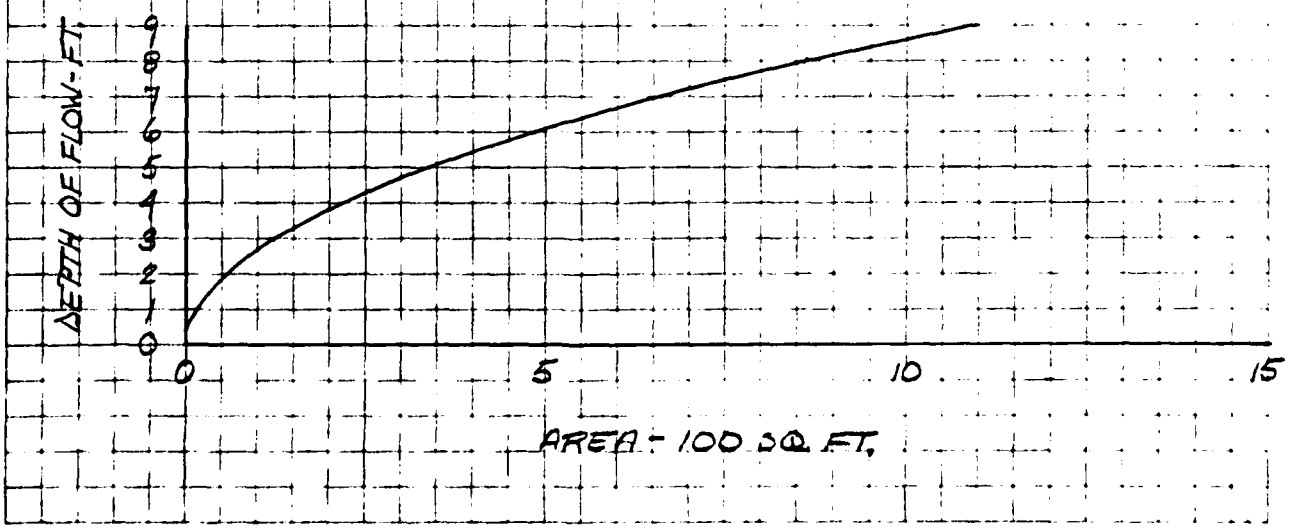
SUBJECT WATERBURY RESERVOIR NO. 2 - FLOOD ROUTING

SECTION NO. 3

Scale: 1" = 100' Horiz.
1" = 20' Vert.

L = 5000 FT.
N = 0.1
S = 0.0516





Reference: "Hydraulic Charts for the Selection of Highway Culverts": HEC No. 5

Note: Assume inlet control at all culvert locations.

Section No 4: (Culvert under Shopping Plaza)

Size - 66" RCP

Hw_{max} - 8 feet

Entrance type - Square edge with headwall

$Hw/D = 8'/5.5' = 1.45$ $Q_{max} = 240$ cfs

Section No 5: (Culvert under Interstate-84)

Size - 2 - 10'x10' Box Culverts

Hw_{max} - 14 feet

Entrance type - 90°

$Hw/D = 14'/10' = 1.4$ $Q_{max} = 128\ cfs/ft \times 10ft \times 2 = 2,560$ cfs

Section No 6: (Culvert under Harpers Ferry Road)

Size - 2 - 10'x10' Box Culverts

Hw_{max} - 6 feet before overtopping the channel banks and flooding residential area.

Entrance Type - 30°-75°

$Hw/D = 6'/10' = 0.6$ $Q_{max} = 45\ cfs/ft \times 10ft \times 2 = 900$ cfs

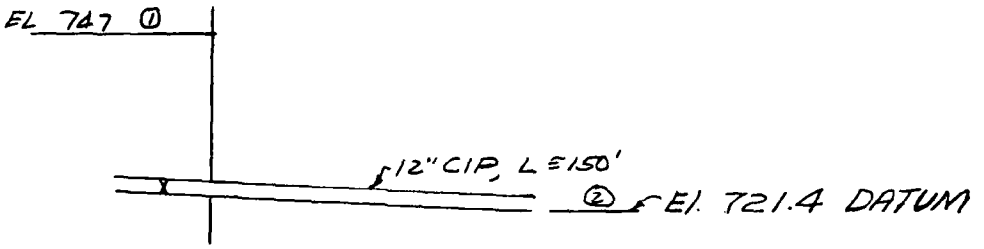
BY SAL DATE 9/17/80 **ROALD HAESTAD, INC.** SHEET NO 18 OF 19
CONSULTING ENGINEERS
CKD BY DLS DATE 9/17/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO 49-025

SUBJECT WATERURY RES. NO. 2 - Blowoff Capacity

Blowoff consists of a 12" CIP approximately 150 feet long and is presently inoperative.

Top of dam El. 747
Inv of blowoff El. 721.4

Head losses: 1) Friction $= f \frac{L}{D} \frac{V_2^2}{2g}$
2) Gate Valve $= K \frac{V_2^2}{2g}$ $(K = 0.25)$
3) Entrance-projecting $= K \frac{V_2^2}{2g}$ $(K = 1)$



$$P_1 + z_1 + V_1^2/2g = P_2 + V_2^2/2g + z_2 + H_{L1-2}$$

$$0 + 25.6 + 0 = 0 + V_2^2/2g + 0 + H_{L1-2}$$

$$25.6 = (1 + 150f + 0.25 + 1) V_2^2/2g$$

Solve by trial & error:

Assume $V_2 = 20$ ft/sec $\rightarrow f = 0.036$ $\therefore V_2 = 14.7$ ft/sec
$V_2 = 15$ ft/sec $\rightarrow f = 0.0365$ $\therefore V_2 = 14.6$ ft/sec

Discharge capacity at top of dam:

$$Q = V_2 A$$
$$= 14.6 \text{ ft/sec} \times \pi(1)^2/4$$
$$= 11.5 \quad \text{use } 12 \text{ ft}^3/\text{sec}$$

BY LBG DATE 8/20/80 **ROALD HAESTAD, INC.** SHEET NO. 19 OF 19

CONSULTING ENGINEERS

CKD BY DLS DATE 8/21/80 37 Brookside Road - Waterbury, Conn. 06708 JOB NO. 49-025

SUBJECT WATERBURY RESERVOIR NO. 2 - SURFACE AREAS

PLANIMETER READINGS:
(Scale: 1" = 2000')

1.) WATERSHED (AREA 1): THIRD 3.25 0.75 X 4 = 3.0 SQ. IN.
FIRST 1.77 0.76
START 1.01

$$3.00\ IN^2 \times \frac{(2000\ FT.)^2}{IN.^2} \times \frac{1\ ACRE}{43{,}560\ FT.^2} = 275\ ACRES$$

2.) WATERSHED (AREA 2): THIRD 1.40 0.05 X 4 = 0.2 SQ. IN.
FIRST 1.30 0.05
START 1.25

$$0.20\ IN.^2 \times \frac{(2000\ FT.)^2}{IN.^2} \times \frac{1\ ACRE}{43{,}560\ FT.^2} = 18\ ACRES$$

TOTAL WATERSHED = AREA 1 + AREA 2 = 275 + 18 = 293 ACRES
= 0.46 Sq. Mi.

3.) ELEV. 748 (WATER SURFACE): THIRD 2.02 0.07 X 4 = 0.28 SQ. IN.
FIRST 1.89 0.07
START 1.82

$$0.28\ IN.^2 \times \frac{(2000\ FT.)^2}{IN.^2} \times \frac{1\ ACRE}{43{,}560\ FT.^2} = 25.7\ ACRES$$

4.) CONTOUR 750: THIRD 1.59 0.10 X 4 = 0.40 SQ. IN.
FIRST 1.40 0.10
START 1.30

$$0.40\ IN^2 \times \frac{(2000\ FT.)^2}{IN.^2} \times \frac{1\ ACRE}{43{,}560\ FT.^2} = 36.7\ ACRES$$

NOTE: The multiplication factor of 4 is a planimeter constant to convert readings into square inches.

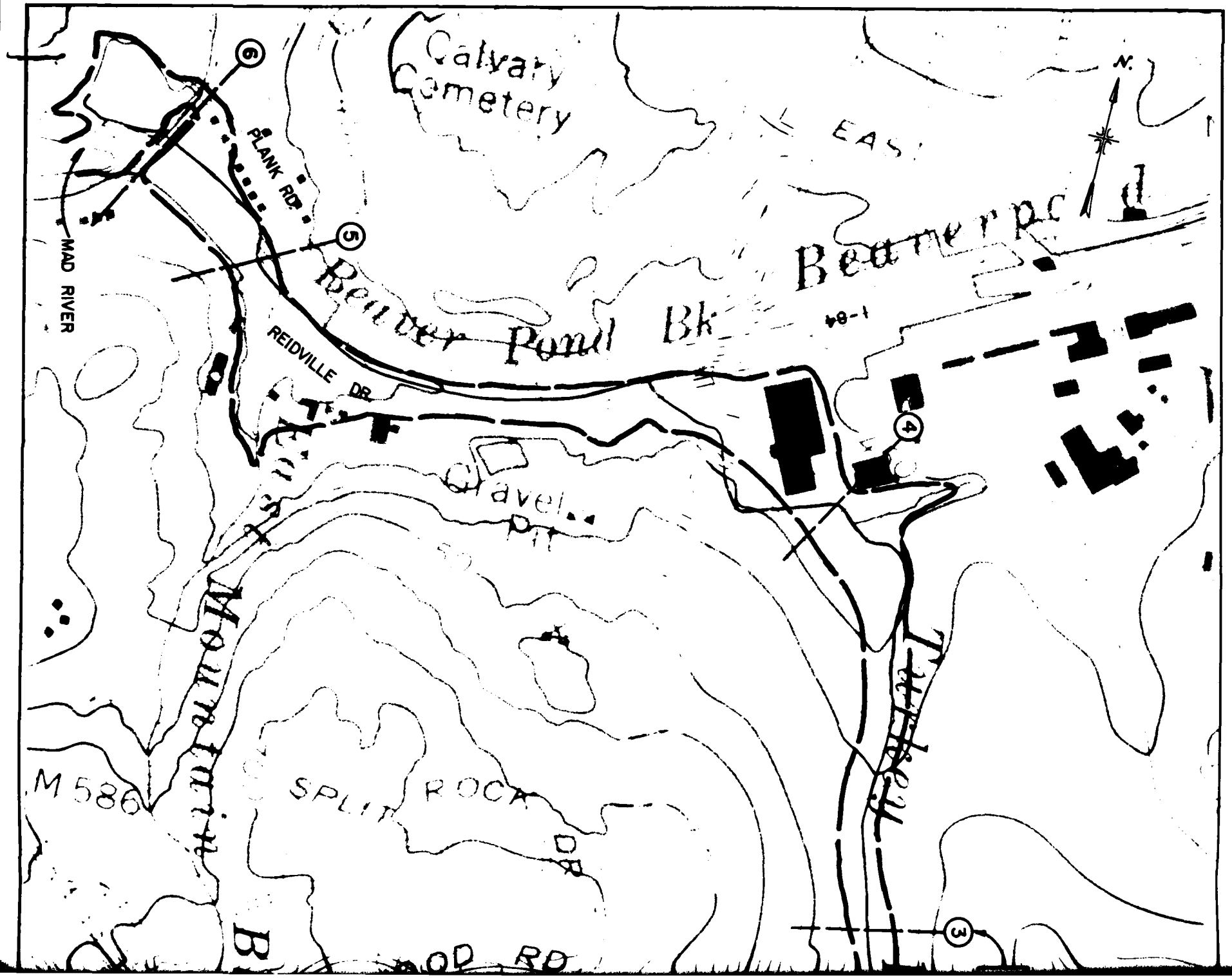
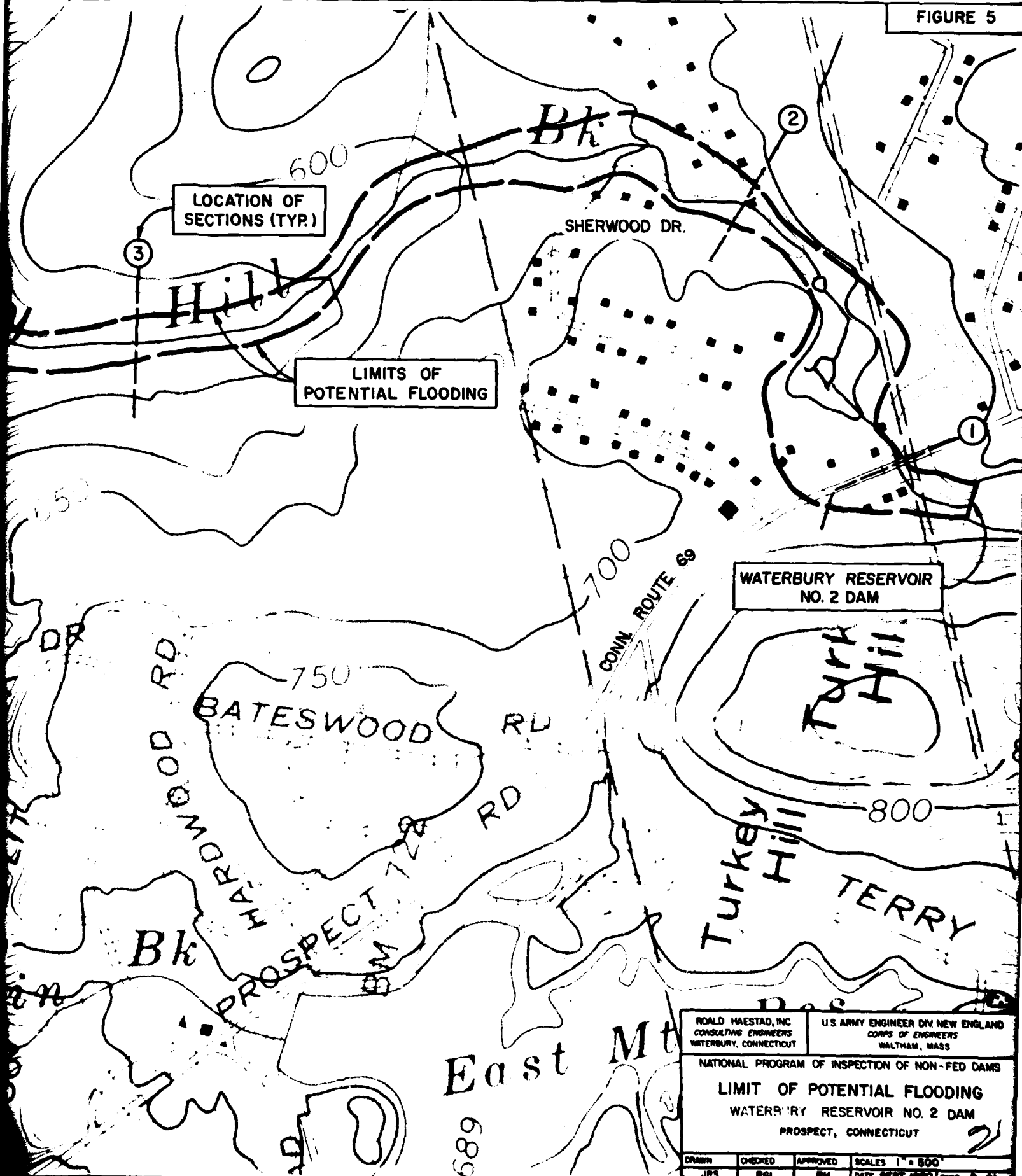

Calvary Cemetery
PLANK RD.
MAD RIVER
REIDVILLE DR.
Boulder Pond Bk
Beaver Pond
Gravel Pit
Mountain
SPLIT ROCK DR
M 586
Turnpike
N.
EAST
6
5
4
3

FIGURE 5



ROALD HAESTAD, INC.
CONSULTING ENGINEERS
WATERBURY, CONNECTICUT

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LIMIT OF POTENTIAL FLOODING
WATERBURY RESERVOIR NO. 2 DAM
PROSPECT, CONNECTICUT

DRAWN	CHECKED	APPROVED	SCALES 1" = 800'
JRS	RGL	RH	DATE SEPT. 1980 PAGE D-21

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME


N
DATE